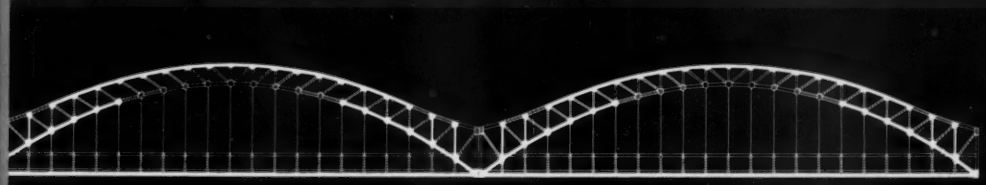
CIVIL ENGINEERING

THE MAGAZINE OF ENGINEERED CONSTRUCTION • NOVEMBER 1961



New Albany Bridge—double-deck tied arch

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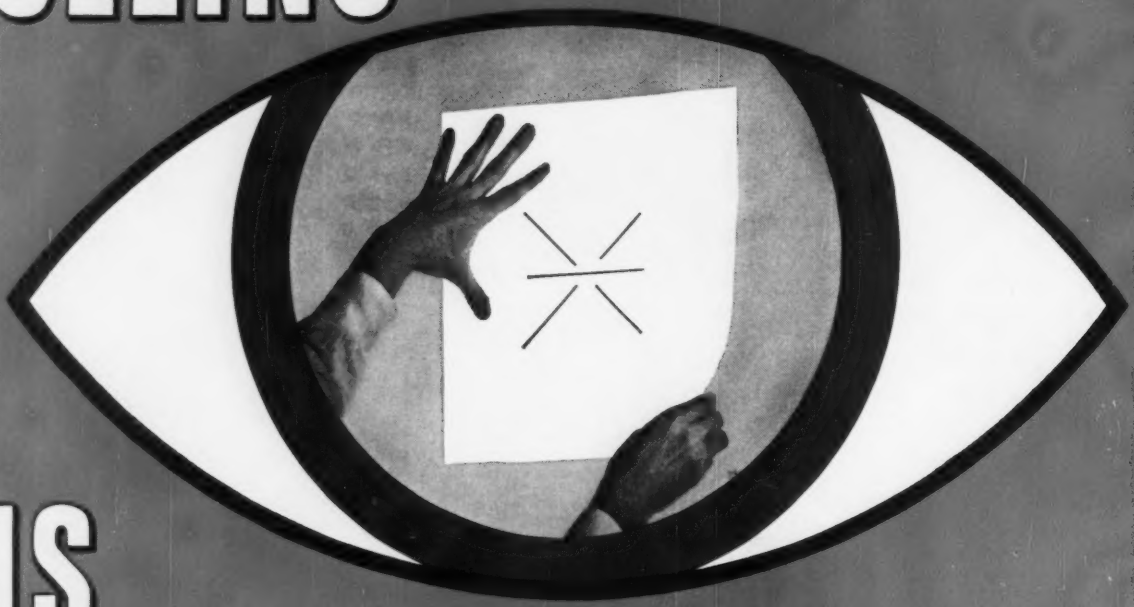

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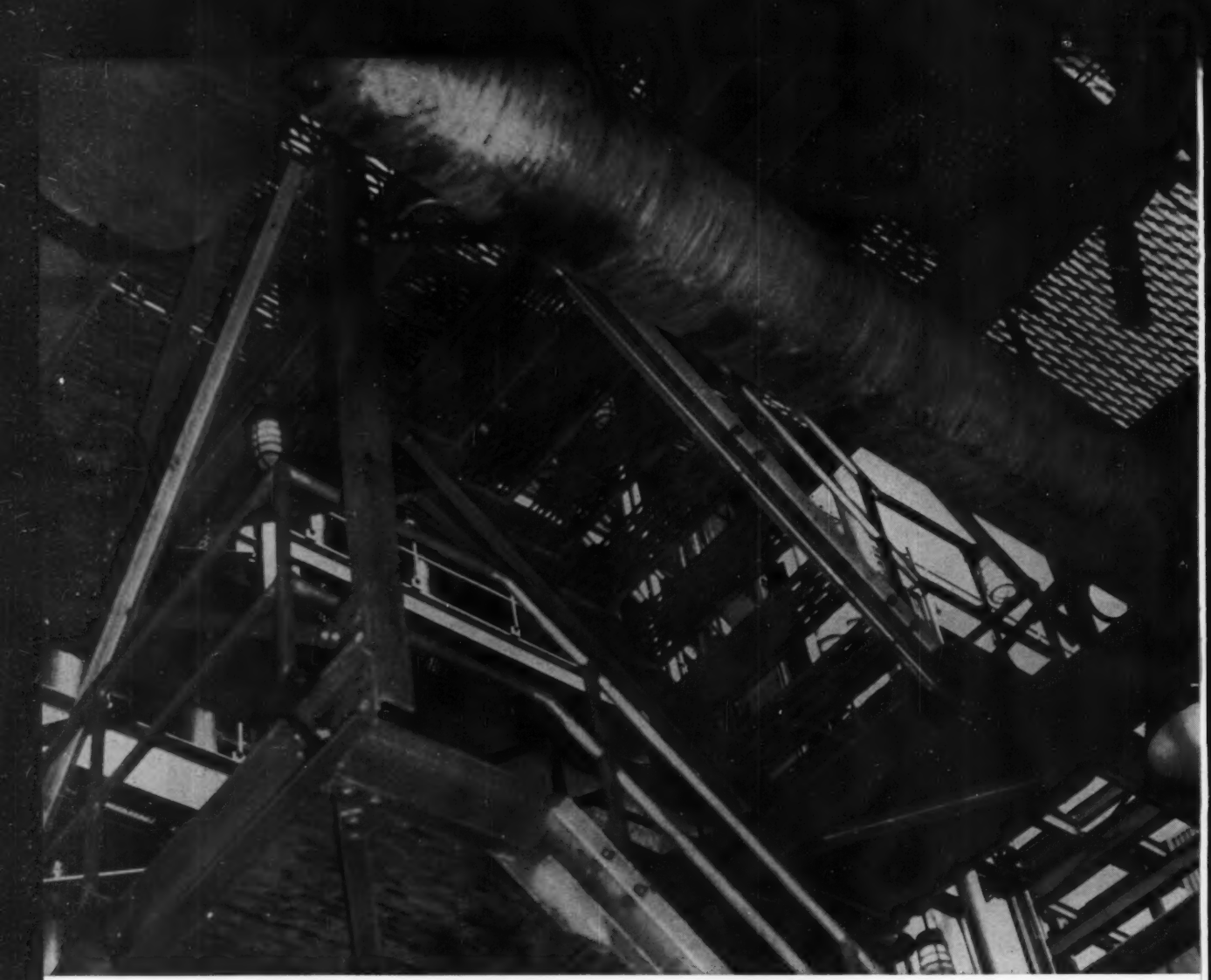

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CIVIL ENGINEERING

NOVEMBER 1961

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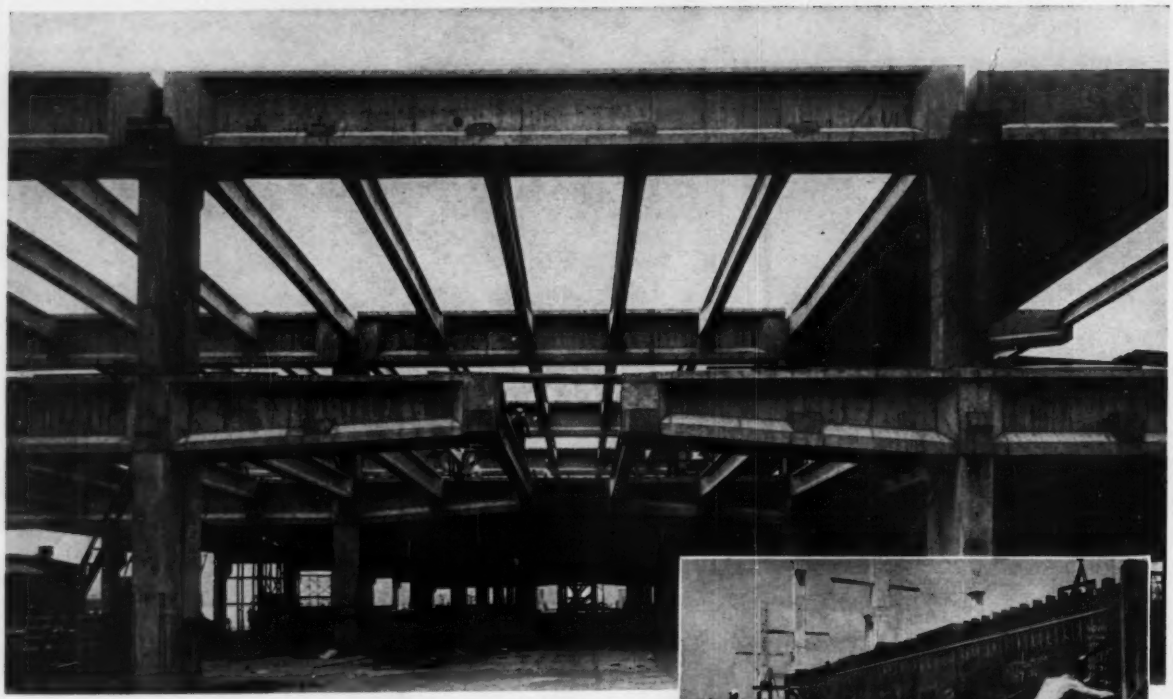

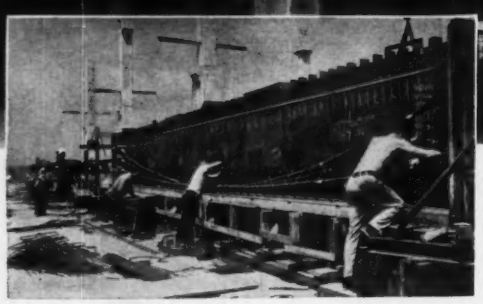

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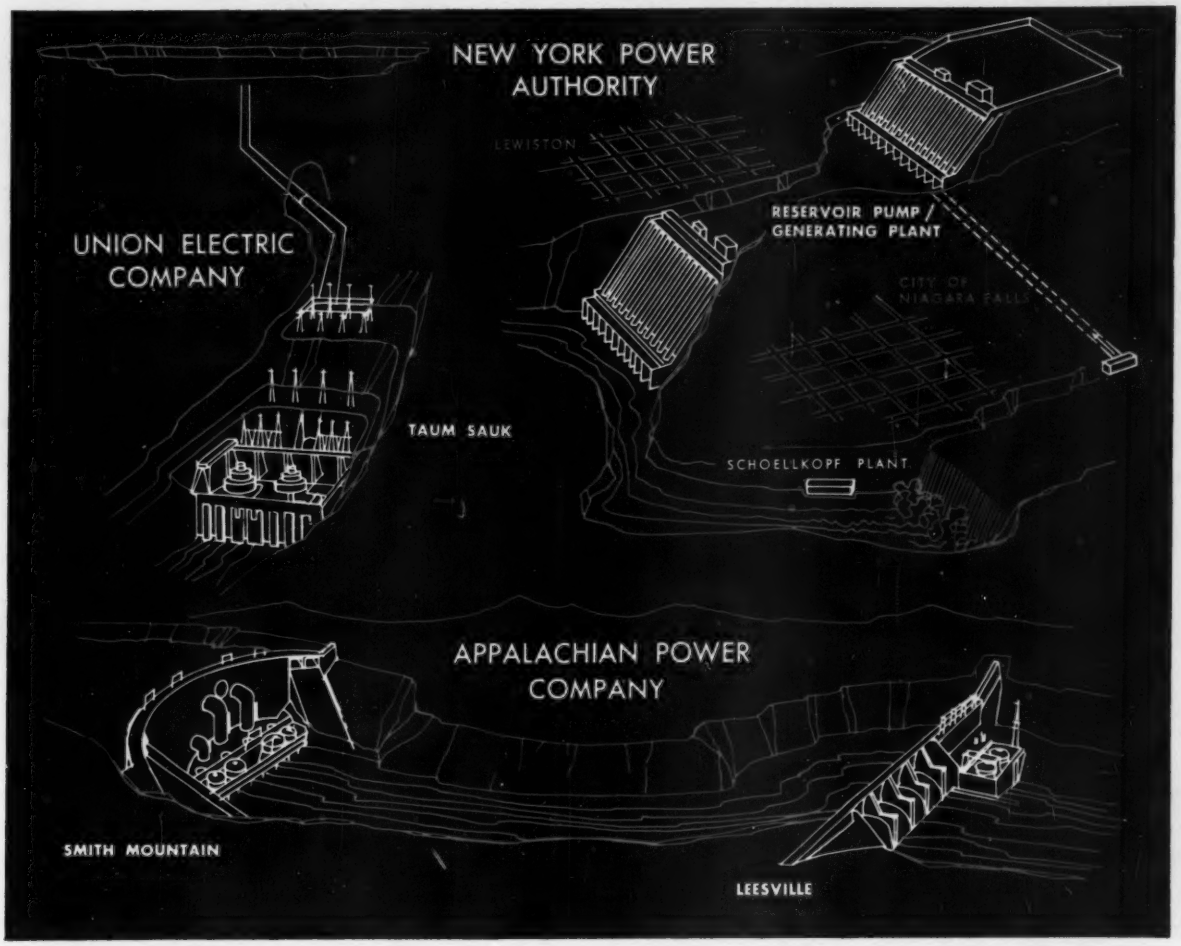

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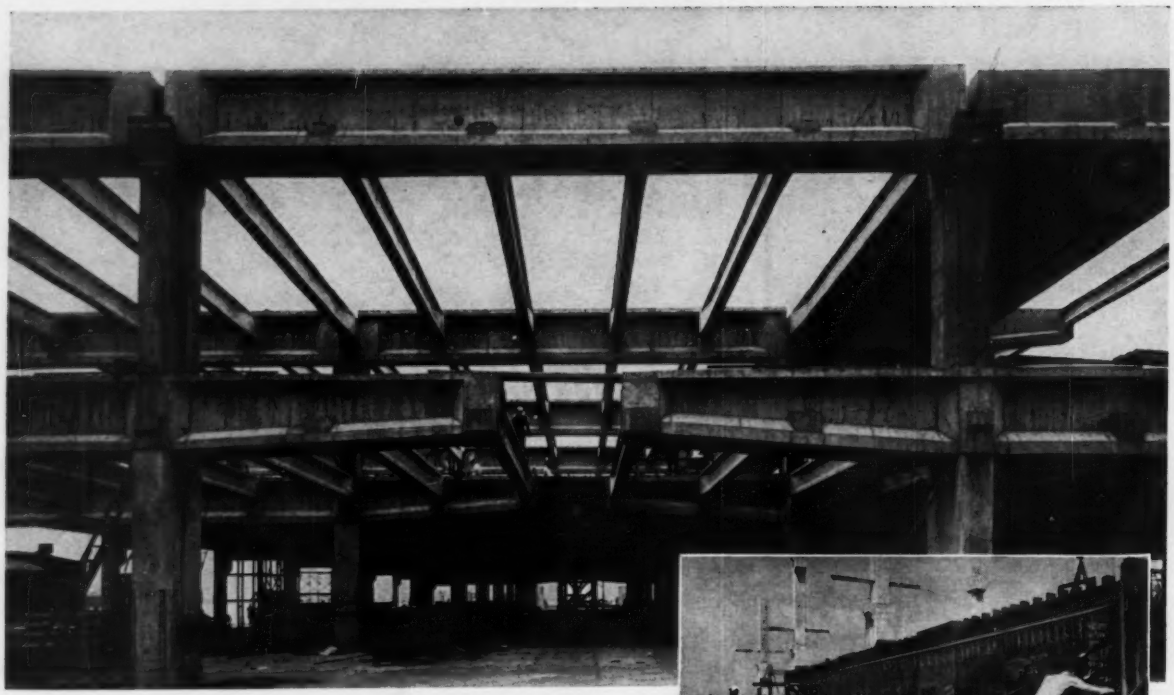
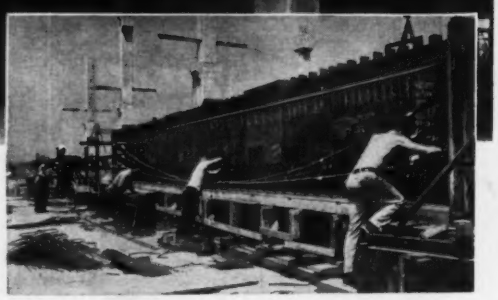
First in run-of-river — at Smith Mountain! This new project involves reservoirs at two successive levels, the lower dam forming a tailrace pool at the upper dam for two A-C reversible pump-turbines, each rated 87,000 hp at 180-ft head. Conventional hydro-generating units will also be installed — two higher-head units at the upper dam and two lower-head units at the lower dam.

For complete information on pumped-storage, hydro-generating equipment or other components for water control, contact your nearby A-C office. Or write to **Allis-Chalmers,** *Hydraulic Division, York, Pa.* A-1383





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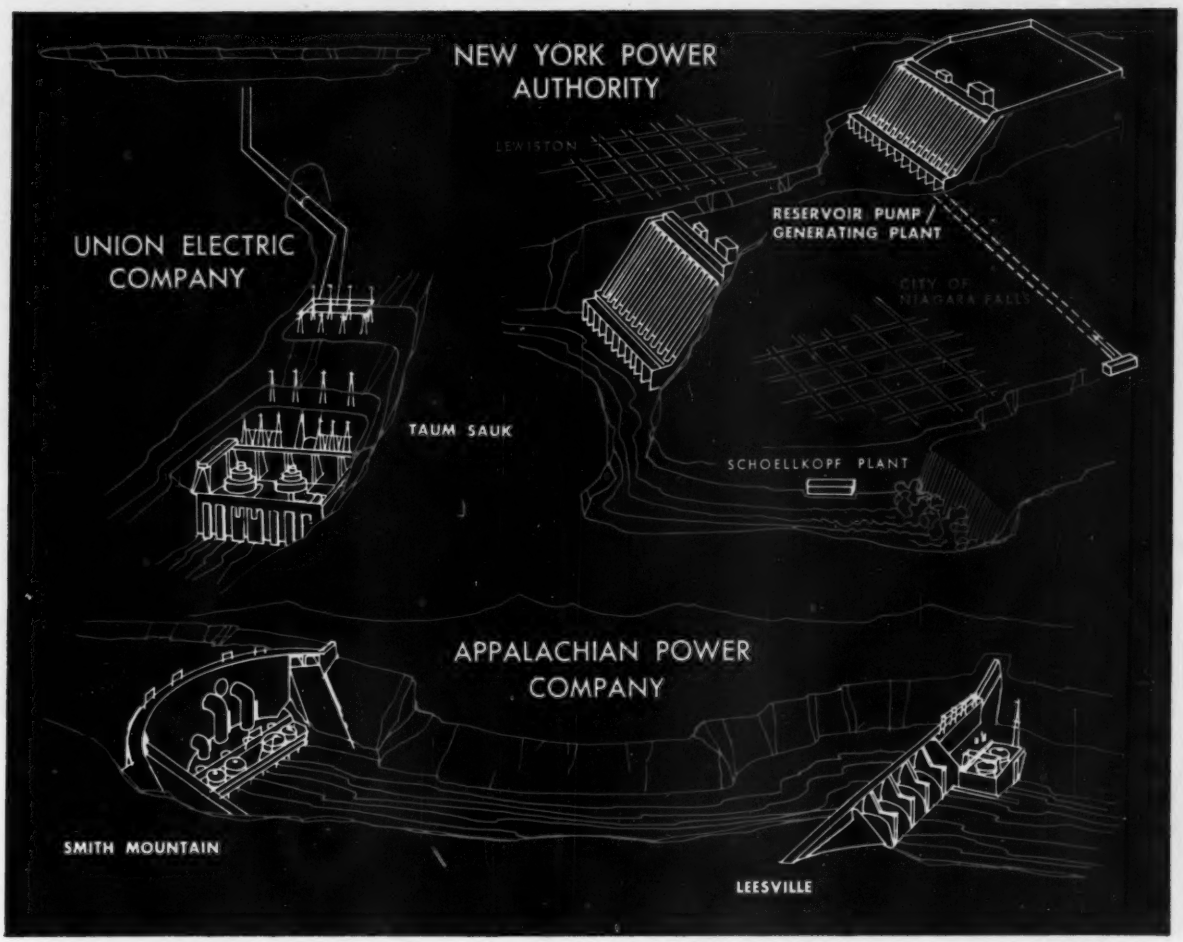

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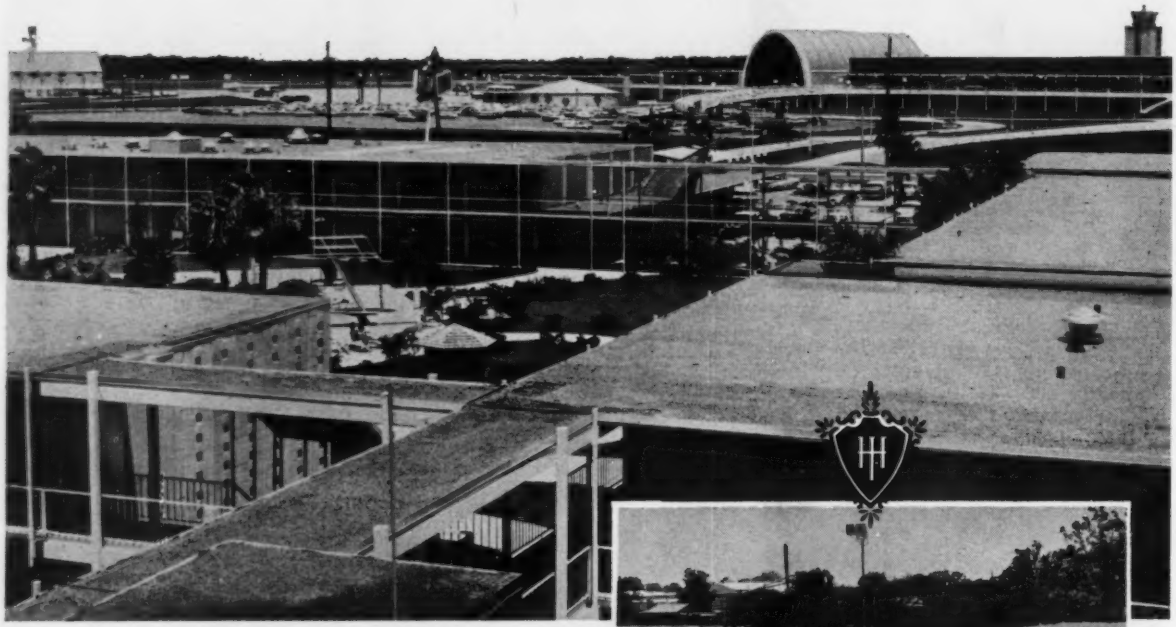

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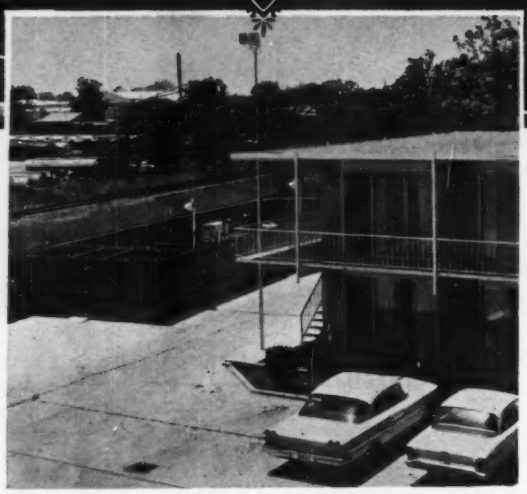

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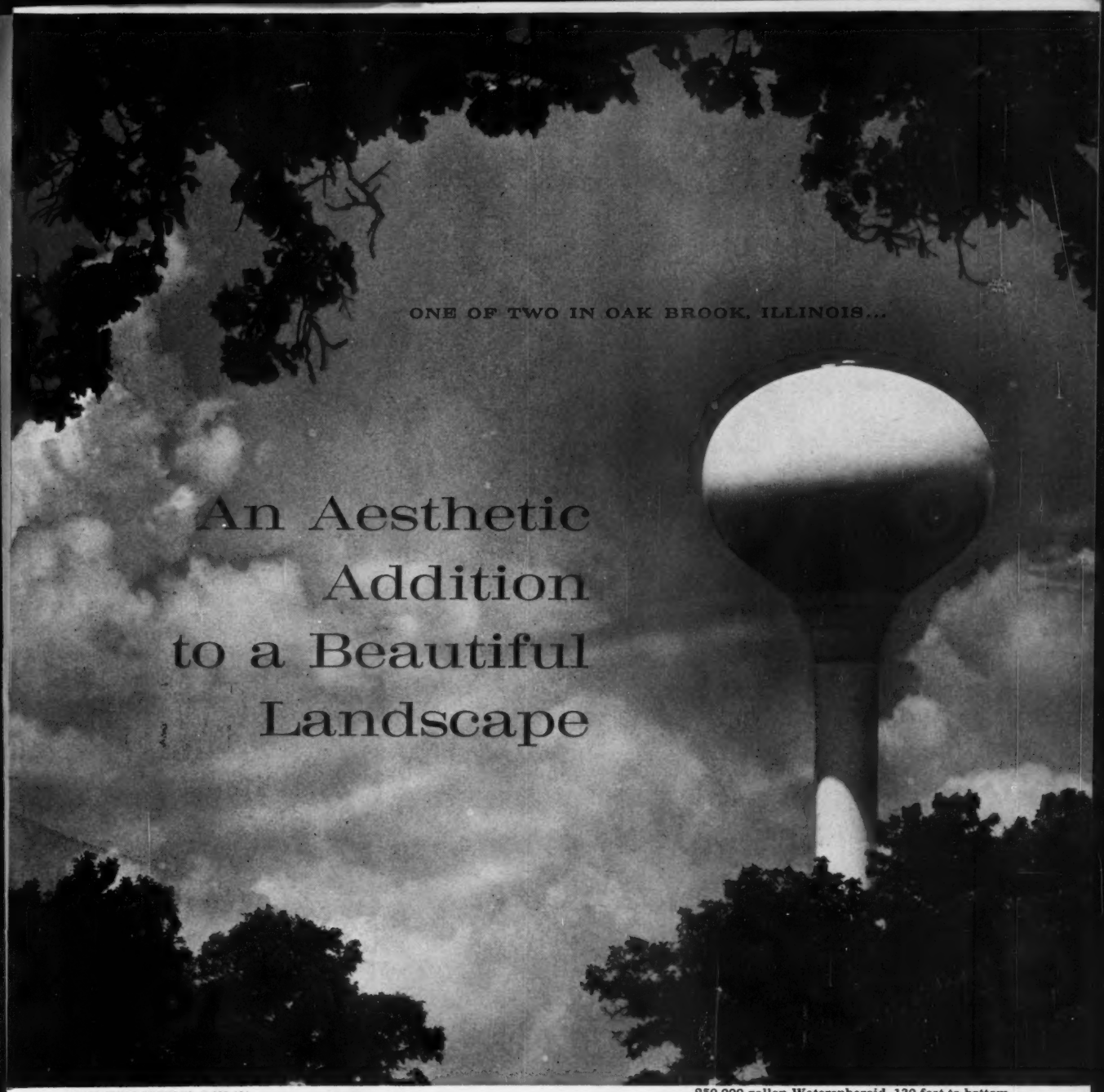

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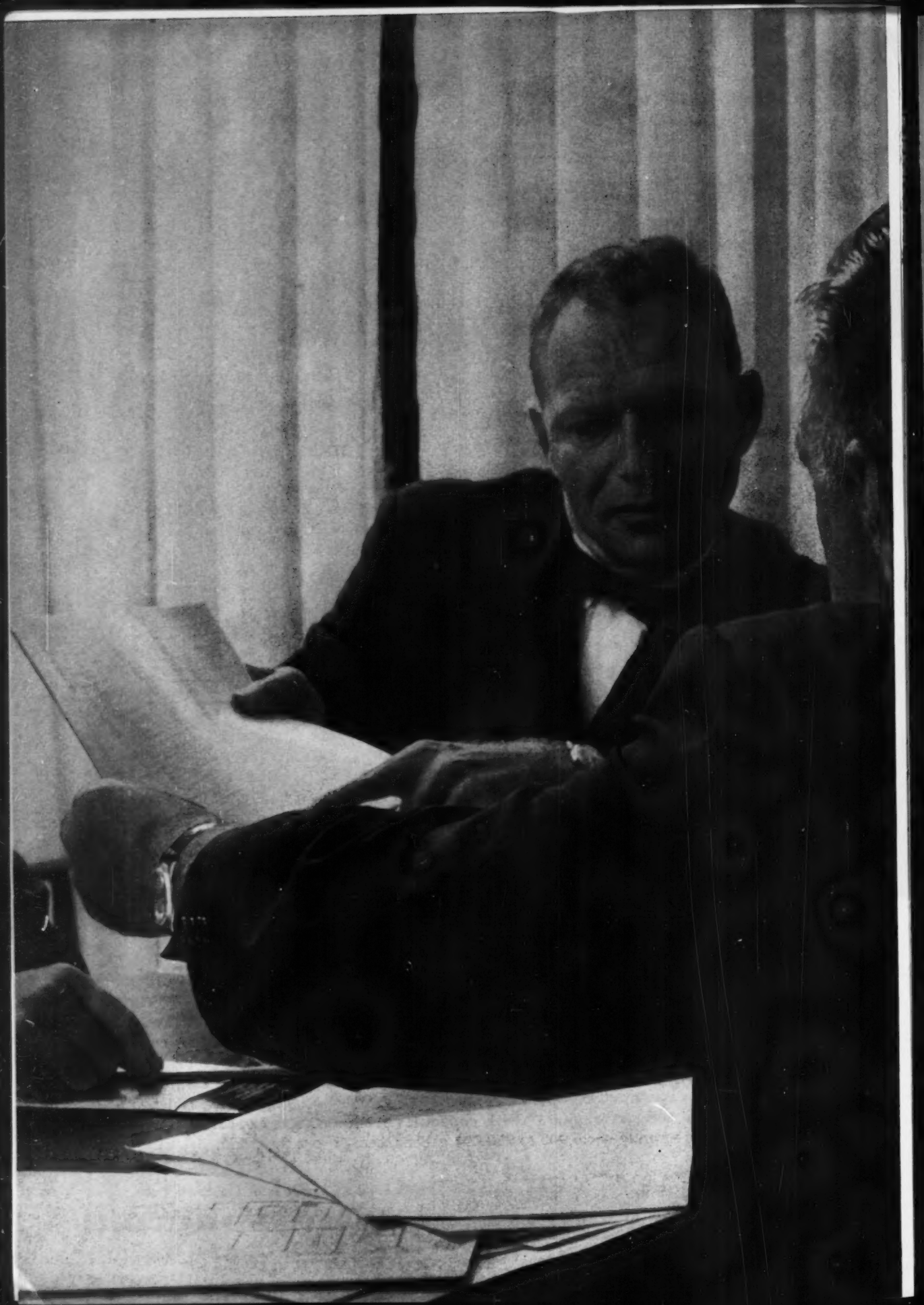

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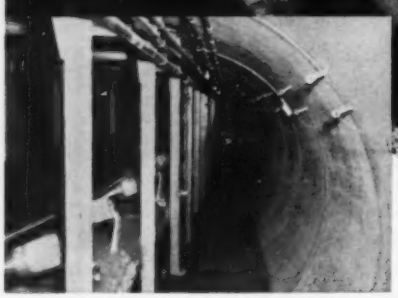

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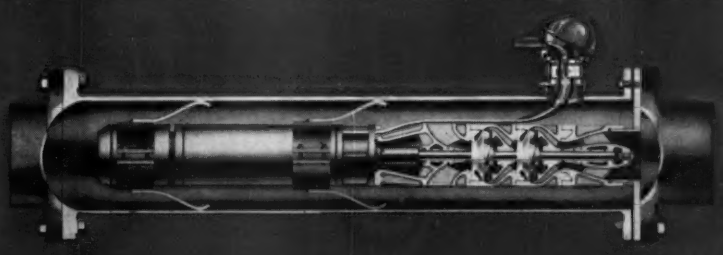

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The Oklahoma Test Road north of Oklahoma City will eventually be part of Interstate route 35

on Oklahoma Test Road 65% lower than asphalt!

COMPLETE RESURFACING AFTER ONLY FIVE YEARS ADDS ANOTHER $43,753 TO ASPHALT'S UPKEEP!

Despite continued surface maintenance for five years, the asphalt pavement on the Oklahoma Test Road has deteriorated to the point where complete resurfacing is required. The asphalt sections are being overlaid with 1½ inches of surfacing to seal out moisture and provide a new wearing course. When comparison is made, as shown here, on the basis of *total upkeep* cost, concrete's advantage is dramatic.

CONCRETE

5-year surface maintenance	$557.82
total surface upkeep	$557.82

ASPHALT

5-year surface maintenance	$1,591.87
complete resurfacing	$43,753.00
total surface upkeep	$45,344.87

Rugged pipe installs easily –even in a soggy bed

This 30″ cast iron pipe was installed for expansion of a water system in Memphis, Tennessee.

Despite heavy rains, the pipe went right to bed in wet trenches. Upon completion, the mains were tested at 150 psi for 12 hours and were found to be bottle-tight.

Cement-lined cast iron pipe prevents pipe-clogging . . . always delivers a full flow of water. Bottle-tight joints are tight enough to resist hundreds of pounds of pressure per square inch . . . yet flexible enough to permit deflection both during and after installation.

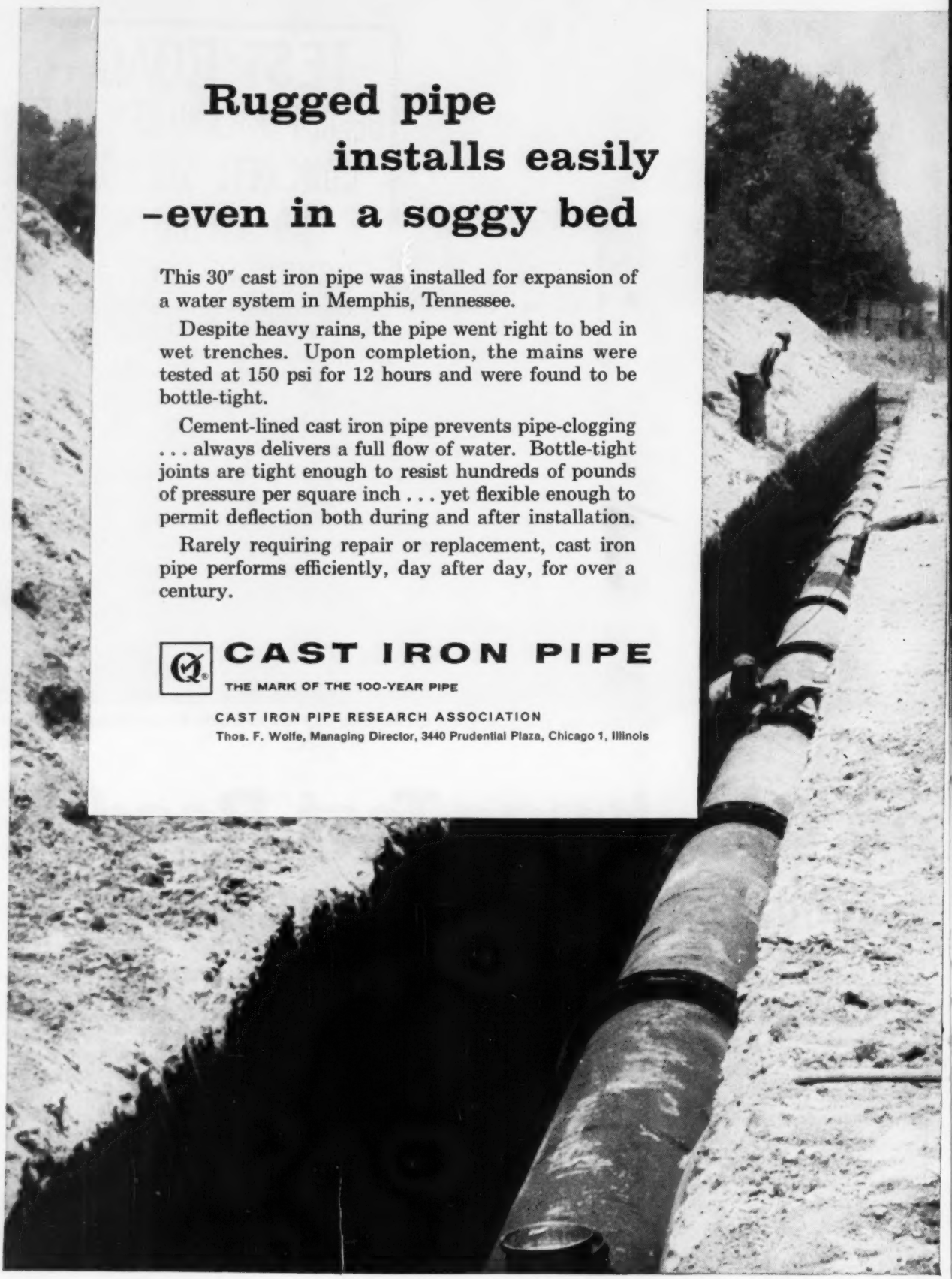
Rarely requiring repair or replacement, cast iron pipe performs efficiently, day after day, for over a century.

CAST IRON PIPE

THE MARK OF THE 100-YEAR PIPE

CAST IRON PIPE RESEARCH ASSOCIATION

Thos. F. Wolfe, Managing Director, 3440 Prudential Plaza, Chicago 1, Illinois



FIRST AV.
M

IS MAIN STREET HEADED FOR A CRACK-UP?

Civic pride starts with good streets, and there's no better way to make sure Main Street, or any other street in town, will keep up appearances than to reinforce it with USS American Welded Wire Fabric.

There is no arguing concrete's compressive strength. It actually improves as the concrete ages. But concrete lacks tensile strength, and steel is at its best in tension. Both compressive and tensile strength are needed to preserve the structural integrity of a concrete slab. Steel welded wire fabric is the ideal high-tensile strength material for concrete reinforcement. It distributes stresses uniformly throughout the slab and controls temperature, moisture, load and soil shift cracking.

Actual measurement has shown that welded fabric's ability to control cracks adds 30% to the strength of the slab.

USS American Welded Wire Fabric is made of cold-drawn wire with a minimum yield strength of 60,000 psi and a minimum tensile strength of 75,000 psi. It is precision-made to your exact size and style requirements, ready for immediate placement. For full information, write American Steel and Wire, Dept. 1279, Rockefeller Building, Cleveland 13, Ohio.

Innovators in Wire USS and American are registered trademarks

American Steel and Wire Division of United States Steel

Columbia-Geneva Steel Division, San Francisco
Tennessee Coal & Iron Division, Fairfield, Ala.
United States Steel Export Company

NEWS OF MEMBERS

Saul S. Seltzer, for the past six years structural engineer for Knoerle, Graef, Bender and Associates, Inc., consulting engineers with offices in Baltimore, Chicago and Salt Lake City, has joined Towers Properties, Inc., of New York City, as director of engineering. Towers Properties is the real estate and development component of Towers Marts International which develops, builds and operates discount department stores and shopping centers throughout the United States and Canada.

Rolf T. Skrinde, who has been engaged in teaching and research at Washington State University since 1958, was recently appointed associate professor of civil engineering there. In the mid-1950's Dr. Skrinde served as sanitary engineering adviser to the governments of Thailand and Saudi Arabia.

Roll-call for water

Why Did Washington Recross the Delaware?

In 1776, General George Washington and his army crossed the Delaware river twice. The first time he was in retreat from British victories in New York. The second time was on the night of Christmas Day when he surprised and defeated the British at Trenton and Princeton, N. J. This turn of the tide of war heartened all American colonists, brought recruits flocking to join the American army and encouraged foreign sympathizers.

Today, Britain is our ally, but there are other nations which are not. Imagine what an atomic war might do to the great cities of these thickly populated South Atlantic states, where in 1607 the "English speaking race cast first root overseas and the United States began."

In these 8 states and the District of Columbia there are 100 water works, each serving 25,000 or more customers. Authorities rate 51 of them as adequate in facilities, 14 as doubtful and 35 as deficient!

America's peacetime shortage of water distribution facilities is a serious threat to a rapidly growing economy. But a wartime shortage of water distribution facilities could be fatal to the Nation's existence. As General Washington turned the tide of war, so must we do now in regard to water distribution facilities.

South Atlantic States
Delaware
Maryland
District of Columbia
Virginia
West Virginia
North Carolina
South Carolina
Georgia
Florida

M&H VALVE
AND FITTINGS COMPANY
ANNISTON, ALABAMA
A WALWORTH SUBSIDIARY

Frederick P. Wiesinger, a native of Hungary who came to the United States in 1950 and joined the civil engineering faculty at the University of Illinois in 1955, recently received his Ph.D. in civil engineering from Northwestern University. Professor Wiesinger in addition to his research activities, is also responsible as consulting structural engineer for the design of a large number of buildings and other structures. His dissertation dealing with a generalization of the Moment Distribution Method includes a direct method which obtains the result without either solving simultaneous equations or using successive approximations.

Roger H. Gilman, director of port development of the Port of New York Authority, is now on loan as executive director to the New York, New Jersey and Connecticut Tri-State Transportation Committee. Following his graduation from Harvard University in 1937, Mr. Gilman joined the Port Authority as a statistician-economist. Then, in 1953, he assumed his present duties of director of port development. Mr. Gilman is currently serving the Society as a Director.

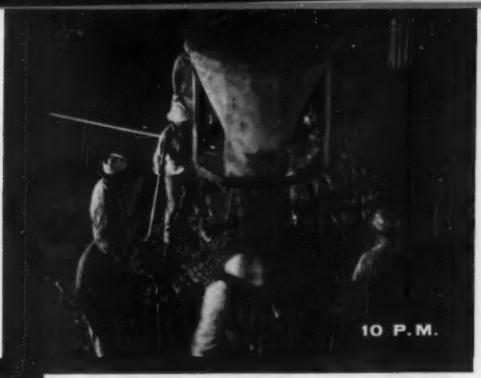
Oliver H. Kollock is retiring after 32 years of service with the Shell Oil Company. He joined Shell in 1929 as a sales engineer in South Carolina, subsequently serving in Asphalt Sales in the New Jersey area and in the Chicago division. Then, in 1946, he joined the New York Division where he has served as asphalt manager for the past 14 years.

Henry C. Goodrich, since 1956 vice president of the Rust Engineering Company of Pittsburgh, Pa., and Birmingham, Ala., was elected a director of the firm last September 20. Mr. Goodrich joined Rust Engineering in 1946 after serving as an officer in the Navy Civil Engineer Corps.

Clarence L. Eckel, dean emeritus of the University of Colorado since July 1960, is currently a visiting professor of engineering at San Diego State College. Another news item from the San Diego college is the recent promotion of **Sanford H. Stone** to the rank of full professor of engineering. The additional responsibility of professor-in-charge of civil engineering has been added to his duties as well.

Lynn W. Pine, a Colonel in the Corps of Engineers, is now director of the Department of Engineering of the Army Engineer School at Fort Belvoir, Va. Colonel Pine was formerly chief of the U.S. Army Military Mission in Bolivia.

(Continued on page 20)



Mr. Arnold Swenson,
Vice President
of Carl N. Swenson Company

HOW A ZEECON FORMULATION CUT PLACING TIME BY 15%

San Jose contractor places 2500 yards of concrete in just 17 hours

By using AquaREX, the Carl N. Swenson Company was able to complete a scheduled 20-hour monolithic pour in only 17 hours. AquaREX is a concrete admixture containing Crown Zellerbach's Zeecon, a controlled cement dispersant.

The 7-story Swenson Building will be the tallest in the new San Jose, California civic center area. Because of adobe soil conditions, a floating pad construction was chosen. It was necessary to construct a single 21,000 square foot slab of reinforced concrete with a minimum compressive strength of 2500 psi.

AquaREX was used for controlled retardation of initial set to prevent cold joints. The admixture reduced water requirements by 10-15%, yet the 5 sack mix was so workable that the pour was completed 3 hours ahead of schedule. Thanks to AquaREX, compressive strength was well over 3000 psi.

Approximately 10,000 yards of concrete—containing AquaREX—will be used in the modern office building. Says Vice President Arnold Swenson, "Do we like AquaREX? Actions speak louder than words: we're using it in our *own* building."

For *your* next job we urge you to consider the advantages of admixtures containing Zeecon. Set-retarding or non-retarding formulations are available, with or without added air entrainment in some areas.

Under construction above: Swenson Building, 7-story luxury building in San Jose, California. Owner-Contractor: Carl N. Swenson Co.; Architect: John S. Bolles (A.I.A.); Concrete Suppliers: San Jose Transit Mix Co.; Concrete Admixture: AquaREX by Concrete Chemicals Corporation, Redwood City, California.

For additional ZEECON information, write to your nearest formulator or to Crown Zellerbach.

AquaREX
Concrete Chemicals Corporation,
725 Warrington Avenue,
Redwood City, California

ChemCon
Florida Laboratories, P.O. Box 672,
Gainesville, Fla.

Econo-Mix
Super Concrete Emulsions, Ltd.,
1372 East 15th St., Los Angeles, Calif.

CONEX
Wescon Products, Ltd.,
3408 West 40th Avenue,
Vancouver, B. C.

EUCON
Euclid Chemical Company,
19218 Redwood Road,
Cleveland 10, Ohio

EZ-POUR
Western Admixture Company,
431 West 4th, Logan, Utah

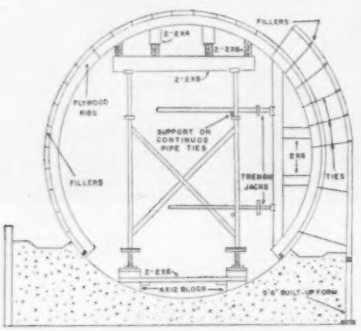
CROWN ZELLERBACH
Chemical Products Division
Camas 42, Washington

60 minutes!

Strip, move, position 32′ gang form section in just one hour . . .

National Engineering and Contracting Co., Cleveland, relied on Symons steel-ply forms to pour a huge quarter mile sewer.

The $400,000 sewer is 13 feet in diameter and 15 inches thick. To meet the 3½ month contract deadline, the inside was formed with three sets of jumbo-mounted Symons forms similar to a gang section. These "jumbos" had hinged ribs



Cross section showing construction features of jumbo form. Workmen, with a block and tackle manually pulled the "jumbo" 30 ft ahead for the next pour.

and rode on plank rails. Each section was 32′ long and was constructed with 12 inch by 8 foot Symons steel-ply fillers. Workmen were able to strip, move a section 30 feet and re-position in one hour. Symons new gang-form bolt simplified assembling and stripping by allowing the ties to be broken back before moving the sections.

For the *complete story, write us.* Ask also about our free engineering service . . . rental-purchase options . . . and complete line catalog.

Symons

SYMONS CLAMP & MFG. CO.

4295 Diversey Ave., Dept. L-1, Chicago 39, Ill.

Warehouses Thruout the U.S.A.

MORE **SAVINGS** FROM **SYMONS**

John A. Hinely, after seven years in the Canal Zone as chief of the Photogrammetric Mapping Branch of the Inter American Geodetic Survey, is now headquartered at Florida's Orlando Air Force Base, where in his capacity as staff geodesist for the Air Photographic and Charting Service he will serve as technical adviser on matters pertaining to programming and planning of geodetic operations. Thus far the civilian scientist has completed 22 years of service to the United States government.

Edward M. Krokosky, a civil engineering graduate student at the Massachusetts Institute of Technology and last year's recipient of M.I.T.'s Max Wasserman Fellowship for the study of plastics, has now been awarded a further fellowship for the study of bituminous concrete. The $4,500 fellowship from the National Bituminous Concrete Association will enable Mr. Krokosky to investigate how different loading rates deform bituminous concrete at varying temperatures and how the material recovers from these deformations.

John T. O'Brien spent two weeks at the Sixth U.S. Army Scientific Seminar on basic research and military technological development recently conducted at the Davis Campus of the University of California. A Lieutenant Colonel at the U.S. Naval Civil Engineering Laboratory at Port Hueneme, Calif., he has served as director of the Harbor Division there.

Nathan M. Newmark, University of Illinois civil engineering department head, recently received the 1961 Vincent Bendix Award for his outstanding research contributions as an engineering educator. He has been at the University since 1930, has been in charge of the structural research laboratory since 1946, and civil engineering head since 1957. Under his leadership the laboratory has attained international recognition.

Denis Temple, until recently special assistant to the executive vice president of the St. Lawrence Cement Company in Clarkson, Canada, has been appointed director of Development. The company, the second largest cement manufacturing company in Canada, engages in cement and steel mill projects throughout North and South America. At present, it has the overall responsibility for engineering and building for the Atlantic Cement Company the largest cement plant ever built before as a single project.

Darrell W. Crawford, C. William Hayes, Edward J. Murphy, J. Dwight Reagan, J. Rodney Lewis, Sigmund R. Petersen, and **Frederick P. Kapinos,** all recent civil engineering graduates, have been commissioned ensigns in the Coast and Geodetic Survey of the U.S. Department of Commerce. They are presently undergoing basic officer training in Washington, D. C., prior to receiving permanent assignments.

Robert E. Stiemke, director of the Georgia Institute of Technology School of Civil Engineering, will be director of the Institute's Engineering Experiment Station. Mr. Stiemke joined the Georgia Tech staff in 1950, after serving during the 1940's as instructor of civil engineering and engineering mechanics at Wayne University and as associate professor of sanitary engineering at North Carolina State College, where he was also in charge of the Engineering Experiment Station. The appointment of **Frederick W. Schutz, Jr.,** as acting director of the Georgia Tech School of Civil Engineering was also approved by the Board of Regents. His earlier experience includes the post of research assistant professor at Lehigh University, as well as industrial experience with the Mobile (Ala.) Steel Company and the Atlanta Refining Company. Dr. Schutz is also active as a consultant in the structural engineering field.

Donald P. Cairns, a project engineer at the Granite City Steel Company in Illinois, has been advanced to plant engineer of the Company's blast furnace department. Mr. Cairns joined the steel organization in 1956, following five years with the Missouri Pacific Railroad Company.

George H. Jennings, well-known San Francisco (Calif.) structural engineer, who joined the Associated Construction and Engineering Company in San Francisco this past summer, is now vice president in charge of engineering. Mr. Jennings, in the construction industry for 27 years, formerly maintained his own consulting firm in Berkeley.

Kenneth R. Brown and **James E. Clyde** announce the formation of the partnership of Barton, Brown, Clyde & Loguidice in Syracuse, N.Y. Employed by O'Brien & Gere in 1945, Mr. Brown was made an associate there in 1951 and office manager in 1959. For part of this time, Mr. Clyde was also an associate of O'Brien & Gere, having joined it in 1952 after previous experience as owner of a contracting business in Florida. Mr. Clyde is a past president of the Syracuse Section.

Leroy F. Greene for the next two years will head the California Legislative Council of Professional Engineers as its duly elected president. Mr. Greene, a consulting engineer of Sacramento, has specialized in the structural engineering field for the last ten years.

Joseph D. Goldreich, formerly supervising engineer at Seelye, Stevenson, Value & Knecht, and **Philip P. Page,** a former associate there, are now co-partners in Goldreich, Page & Thropp. The firm's offices are at 257 Park Avenue South, New York, N.Y.

Hugh Mulholland, formerly an engineering representative for Daniel, Mann, Johnson and Mendenhall, and manager

of metropolitan sales for Armco Drainage and Metal Products, Inc., has been named executive vice president of the Southern California Steel Council. Mr. Mulholland will work with city, county and state officials to effect beneficial construction code changes.

LeRoy F. Johnson, after 46 years of state highway service, is retiring as maintenance engineer of the New Hampshire Public Works and Highways Department. He has been in this post since 1934. One-time chairman of the Snow and Ice Control Committee of the Highway Research Board, Mr. Johnson is widely recognized in the United States and abroad for his high standards of winter road maintenance. His innovations include constructing gravel cores with side drains to stabilize embankments, using support slabs under highway approaches to bridge-decks to prevent settlement, and new methods of bituminous surface-treating granite state highways to improve their riding qualities.

Morton I. Goldman, formerly nuclear installations consultant with the Division of Radiological Health, Public Health Service, has joined Nuclear Utility Services, Inc., of Washington, D.C. In his new capacity Dr. Goldman will be active in the fields of radioactive waste disposal and reactor environmental safeguards.

Robert W. F. Mosby, design engineer for Harland, Bartholomew and Associates and Clark, Daily and Dietz, both of Memphis, Tenn., has now been named general field engineer for the Tennessee district of the Portland Cement Association. His past professional associations include construction and maintenance work in Jackson, Tenn., and in the Chicago office of the vice president and chief engineer of the Illinois Central Railroad.

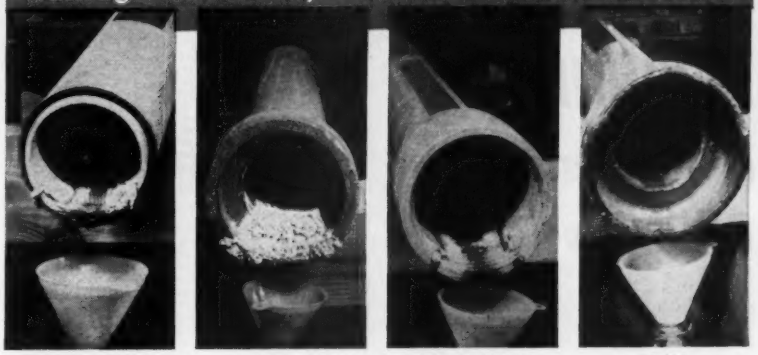
R. K. Bernhard, professor of engineering mechanics at Rutgers University in New Jersey, has received the honorary degree of Doctor of Engineering from the Technical University of Berlin (Germany) for his contribution toward the "development of new methods for testing engineering materials and structures and as pathfinder in the Science of Soil Dynamics." Mr. Bernhard has also done consulting work in his area of specialization.

Robert M. Arnold was named president and partner in the Beiswenger, Hoch, Arnold, and Associates, engineering firm of Cleveland. Mr. Arnold, who also was elected to the board of directors, joined the firm in 1953, serving as chief civil engineer until 1958 when he was named vice president. The firm's Cleveland offices have been moved to 3510 Chester Avenue.

(Continued on page 22)

only CLAY meets the ACID TEST!

Unretouched photos show corrosion damage caused by the flow of acid solution.



CEMENT-ASBESTOS | CONCRETE | CEMENT-ASBESTOS FOREIGN | CLAY

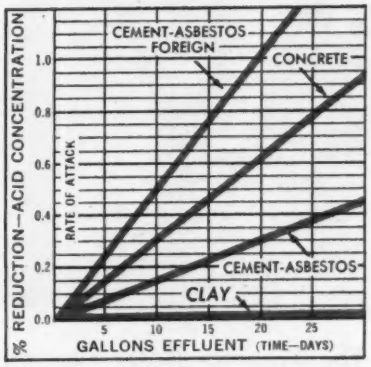
*Manufacturers' brand names deleted.

It's sulphuric acid that destroys sewer lines made of materials bought as substitutes for lifetime Vitrified Clay Pipe. And sulphuric acid—which combines chemically with the binding material in other products to disintegrate them—can't hurt Vitrified Clay, a completely inert material.

Special tests at the Clay Pipe Industry's modern laboratory at Crystal Lake, Illinois, recently illustrated just how damaging this acid concentration can be.

As you can see in these photographs and the chart, the acid started eating up the substitute materials quickly. But it didn't do a thing to lifetime Vitrified Clay.

It's a simple test. Try it yourself before you specify any product for your sanitary sewers other than Vitrified Clay. We just pumped 30 gallons of 8.6 percent sulphuric acid by weight through four different pipe specimens



—in this case, domestic cement-asbestos, concrete, foreign cement-asbestos and clay.

Remember, you can't argue with the facts, and you can't repeal the laws of science. Sewer gas and oxygen are present in all sanitary sewers. And sewer gas and oxygen combined add up to sulphuric acid, which destroys substitutes for Vitrified Clay Pipe.

NATIONAL CLAY PIPE MANUFACTURERS, INC.
1028 Connecticut Ave., Washington, D. C.

Please send me full details on the results of the acid tests on the four sewer pipe materials shown here.

(name)

(company)

(street address)

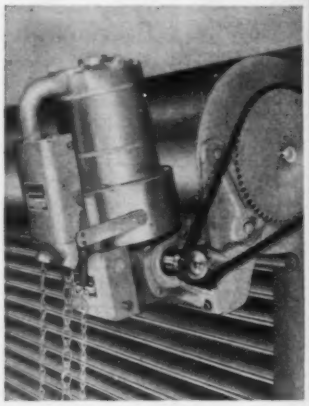
(city and state)

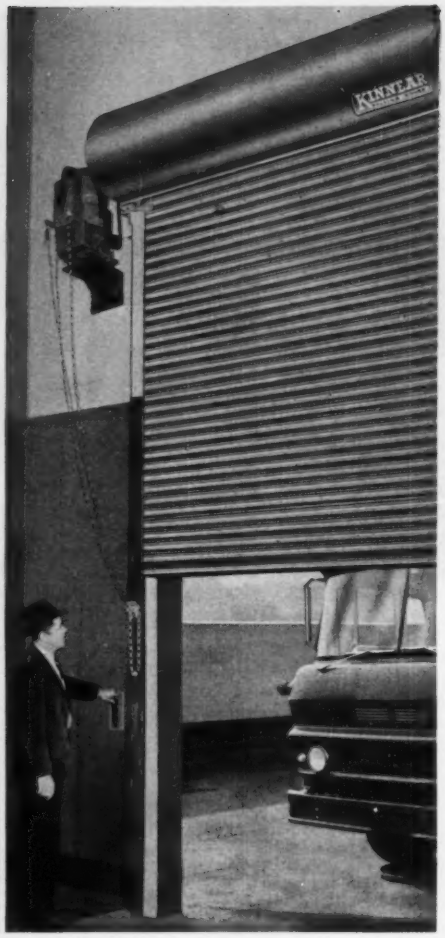
B-6C23 CE

COMPRESSION SEALED, VITRIFIED
CLAY PIPE
IMPERVIOUS
THE STANDARD in SANITARY SEWERS

NATIONAL CLAY PIPE MANUFACTURERS, INC.
1028 Connecticut Avenue, N.W.
Washington 6, D. C.

There's a "Powerful Difference" in KINNEAR Motor Operated Rolling Doors!





The Kinnear Motor Operator is NEW in every detail -- AND BUILT EXCLUSIVELY FOR DOOR SERVICE

Kinnear's new Power Operator for rolling doors is a specific-purpose unit. All features are uniquely integrated for door control that combines highest efficiency and durability.

Its *reserve power* assures smooth action that defies wind pressure, drifted snow, collected grime, or extra years of usage.

Special thermal protection prevents overload troubles — the motor cuts out before damage can occur.

New worm gearing takes "stop and go" action in its stride!

A new centrifugal clutch transmits motor action to the door without shock, increasing protection against motor stalls and overload damage.

The new power unit permits easy removal for servicing without disturbing the auxiliary hand-chain operator.

Seven sizes fit all door needs without costly "over-powering." Can be installed vertically or horizontally . . . bracket-mounted on the door or wall, or for through-the-wall operation.

Kinnear originated the door with the curtain of interlocking slats that opens upward, coils compactly overhead, and saves floor, wall and ceiling space. This new Power Operator brings the basic efficiency of Kinnear Doors to a new high in dependable, push-button convenience. *Write for complete information on Kinnear Rolling Doors and Power Operators.*

The KINNEAR Manufacturing Company

KINNEAR® ROLLING DOORS
Saving Ways in Doorways

FACTORIES:
1080-90 Fields Avenue, Columbus 16, Ohio
1742 Yosemite Avenue, San Francisco 24, Calif.
Offices and Representatives in All Principal Cities

Aubrey Horn, a veteran in the international construction and engineering fields, has been named a vice president and director in Flewelling, Moody & Horn (until recently Flewelling and Moody), of Los Angeles, Calif. Formerly vice president and chief engineer for 14 years for the W. E. Kier Construction Company, he recently completed four years with Daniel, Mann, Johnson & Mendenhall as vice-president in charge of international operations and business development.

William R. Garrett, Jr., a member of the Merrimack College engineering faculty since 1954, has been named director of the school's division of engineering. He formerly taught at Kansas State University and at Louisiana State University.

W. Orme Hiltabidle, a retired Vice Admiral in the Navy Civil Engineer Corps and a former vice president of the Charles H. Tompkins Company, has joined DeLeuw, Cather & Company as a consultant. He will maintain offices in Washington, D.C., at 1308 18th Street.

Ethan F. Ball during 47 years with the Bethlehem Steel Company supervised the engineering on many important structures. Now, as a result of impending retirement, his duties as chief engineer of

Ethan F. Ball

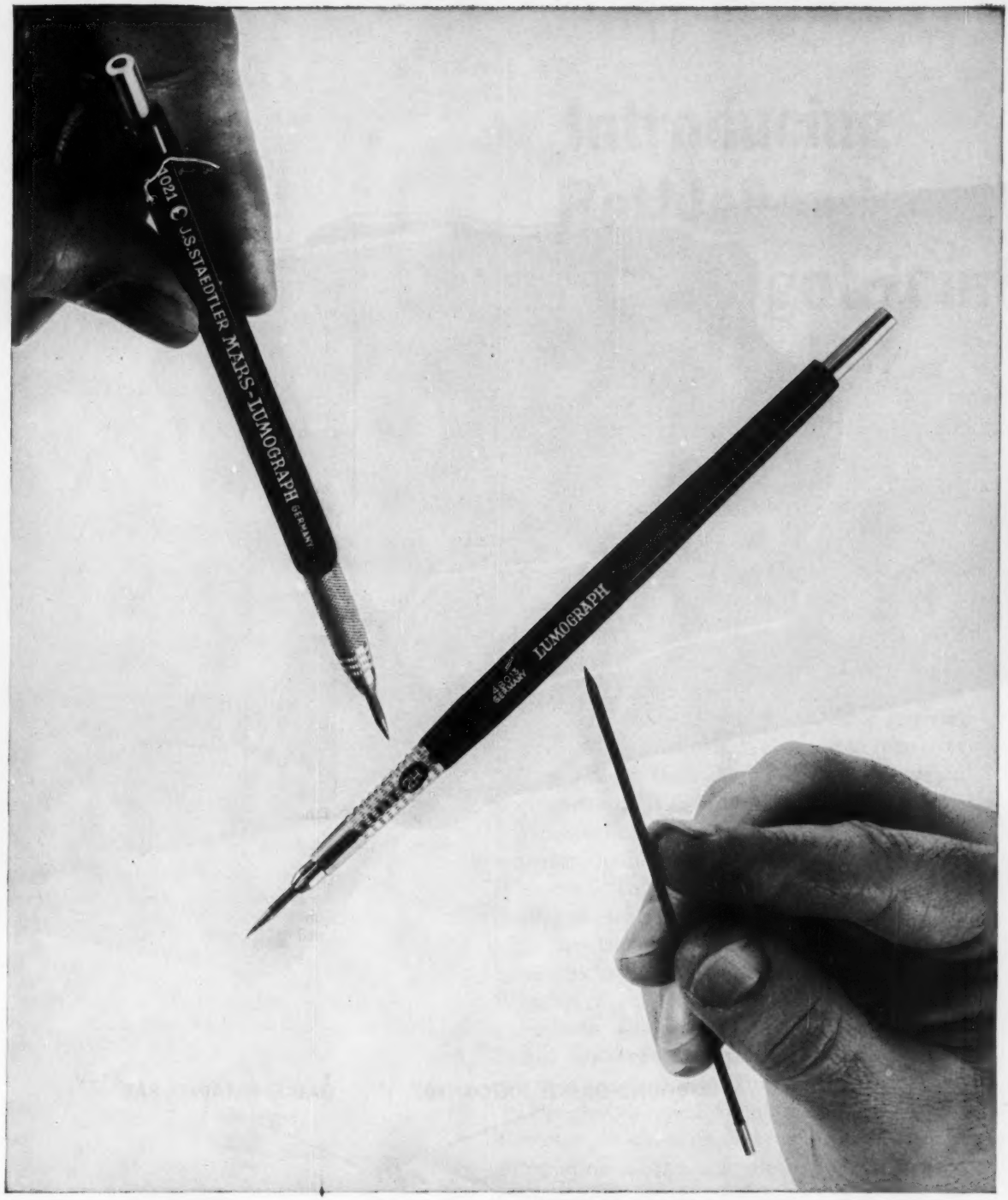
W. H. Jameson

the Fabricated Steel Construction Division will be taken over by a successor, **William H. Jameson.** Mr. Jameson joined the Bethlehem organization in 1931, became assistant engineer in the Fabricated Steel Construction Division in 1938, and assistant chief engineer in 1952.

George H. Taylor recently retired after 35 years of service with the Water Resources Division of the U.S. Geological Survey, 34 of them in the Ground Water Branch. During this time he pioneered ground-water studies of the entire State of Utah, was regional engineer of the Survey's ground-water investigation in the Missouri River basin and, most recently, was operations research engineer for the Ground Water Branch. He was awarded the Army's Letter of Commendation for his role during World War II in the planning and initiation of the Alcan Highway, the organization of the European Theater of Operations in Great Britain, and the mounting of the African invasion.

James A. McCarthy as a newly elected director of the National Council of State Boards of Engineering Examiners will serve a two-year term. He is currently professor of civil engineering at the University of Notre Dame in Indiana.

(Continued on page 107)



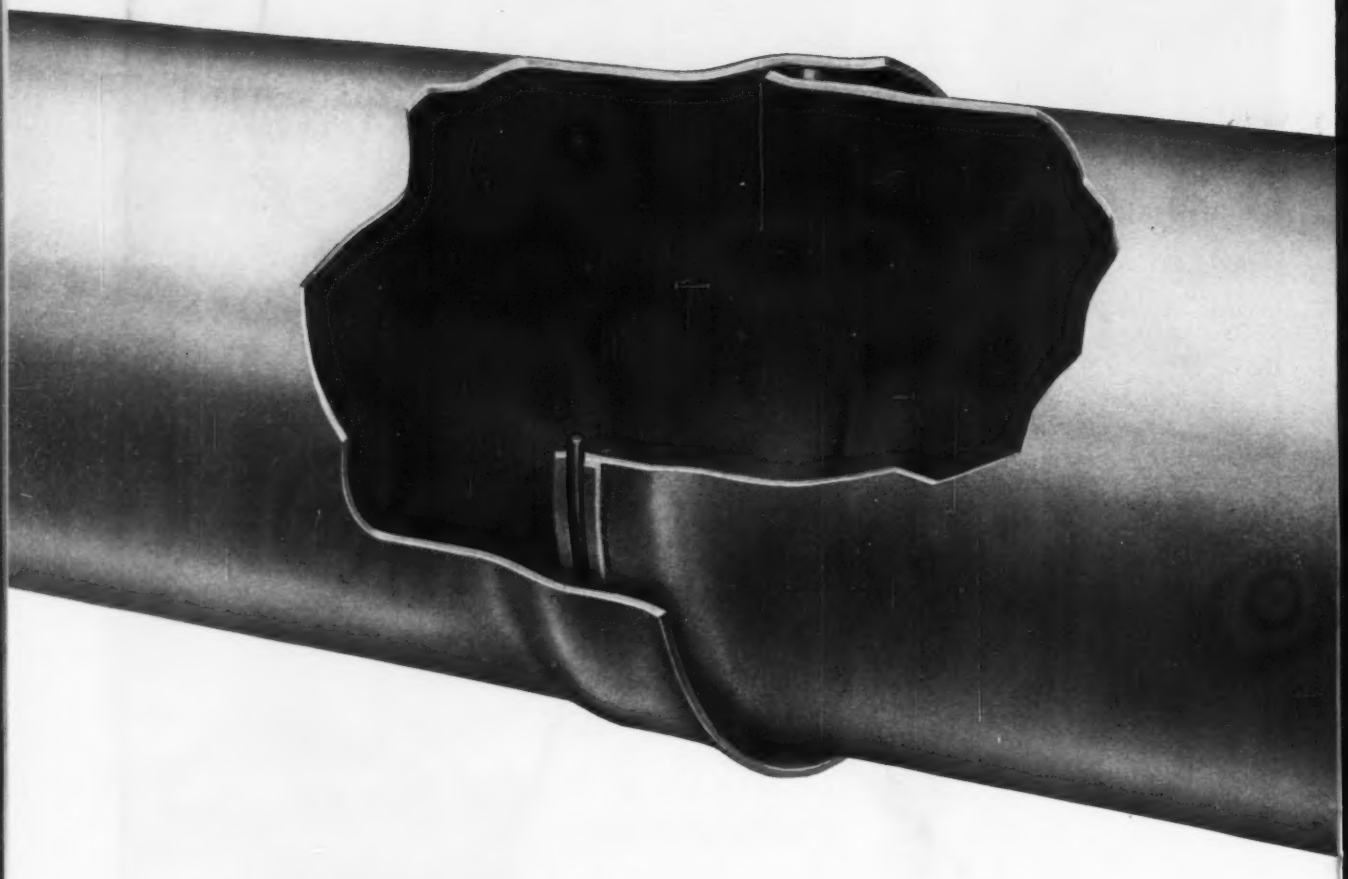
LATEST WORD FROM MARS
is the superb new Technico lead holder—with clear-view degree indicator placed right at your fingertips. Contoured for perfect balance, with new positive finger grip, it's the newest of many fine MARS drafting aids—all designed to make your work easier, and to make it look better and reproduce better.

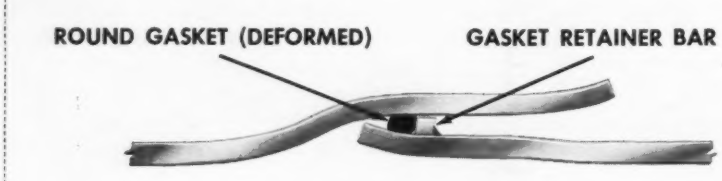
Among the famous imported Mars drafting products are: the Mars-Technico push-button lead holders (with adjustable degree indicator*, with specific degree imprint, the economy model*); Mars-Lumograph drawing leads*, 18 degrees, EXB to 9H; Mars-Lumograph drawing pencils, 19 degrees, EXEXB to 9H; Mars-Duralar pencils and leads for drafting on Mylar® -base drafting film —5 special degrees, K1 to K5; Mars-Duralar Technicos with adjustable Duralar degree indicator; Mars-Lumochrom colored drawing pencils, 24 shades. Also: Mars Pocket-Technico for field use; Mars pencil and lead sharpeners; Mars Non-Print pencils and leads; Mars-Duralar erasers. Mars products are available at better engineering and drafting material suppliers everywhere.

®T.M. for duPONT's Polyester film. *Shown.

the pencil that's as good as it looks

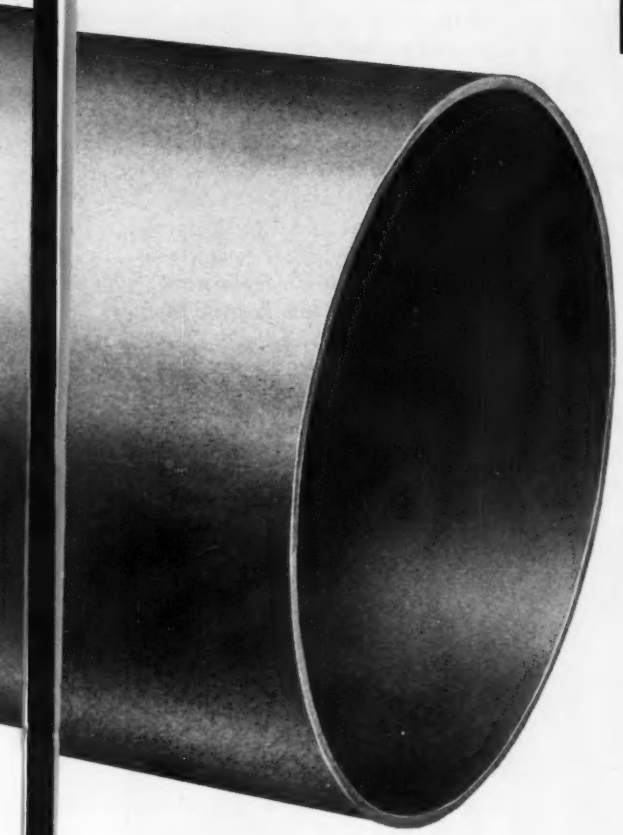
MARS
J.S. STAEDTLER, INC.
HACKENSACK, NEW JERSEY





SECTION

Introducing Bethlehem's Bell-and-Spigot Joint, with Gasket



Here's a joint that promises new ease and speed of installation, added to the many well-known advantages of *steel* pipe.

We make it in diameters from 24 in. through 120 in., but if you have something a little smaller or larger in mind, let's talk it over.

And this joint is *tight.* We've tested it to over 450 psi (more than double ordinary working pressures) *and it didn't leak a drop.*

We can line and coat the pipe at the shop with top-quality coal-tar enamel, and wrap it if desired. This gives you the best, longest-lasting protection that money can buy, plus high flow capacity. But if other coating combinations are preferred, we'll supply the pipe to comply.

As with all steel pipe, every single 40-ft length undergoes a hydrostatic test well in excess of the design working pressure.

If you're thinking about installing a large-diameter water main, let us give you more information about our new Bell-and-Spigot Pipe. We suggest that you have a talk with the people at the Bethlehem sales office nearest you.

Steel

for Strength
. . . Economy
. . . Versatility

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA. Export Sales: Bethlehem Steel Export Corporation

BETHLEHEM STEEL

BETHLEHEM STEEL

HERE'S HOW TO MOVE 18 MILLION GALLONS OF WATER EVERY DAY

In virtually constant use, Peerless pumps insure dependable water flow to utility's 18,000 customers . . .

The Dominguez Water Corporation has a colorful history that dates back to the early Spanish land grants in California. It was first formed in 1911 and its initial patrons were farmers of land which formed a part of the historically famous Rancho San Pedro.

Today this privately owned public utility serves over 17,000 residences and 1,000 agricultural and industrial customers. Its service area comprises a 35 square mile section in the southern part of Los Angeles County.

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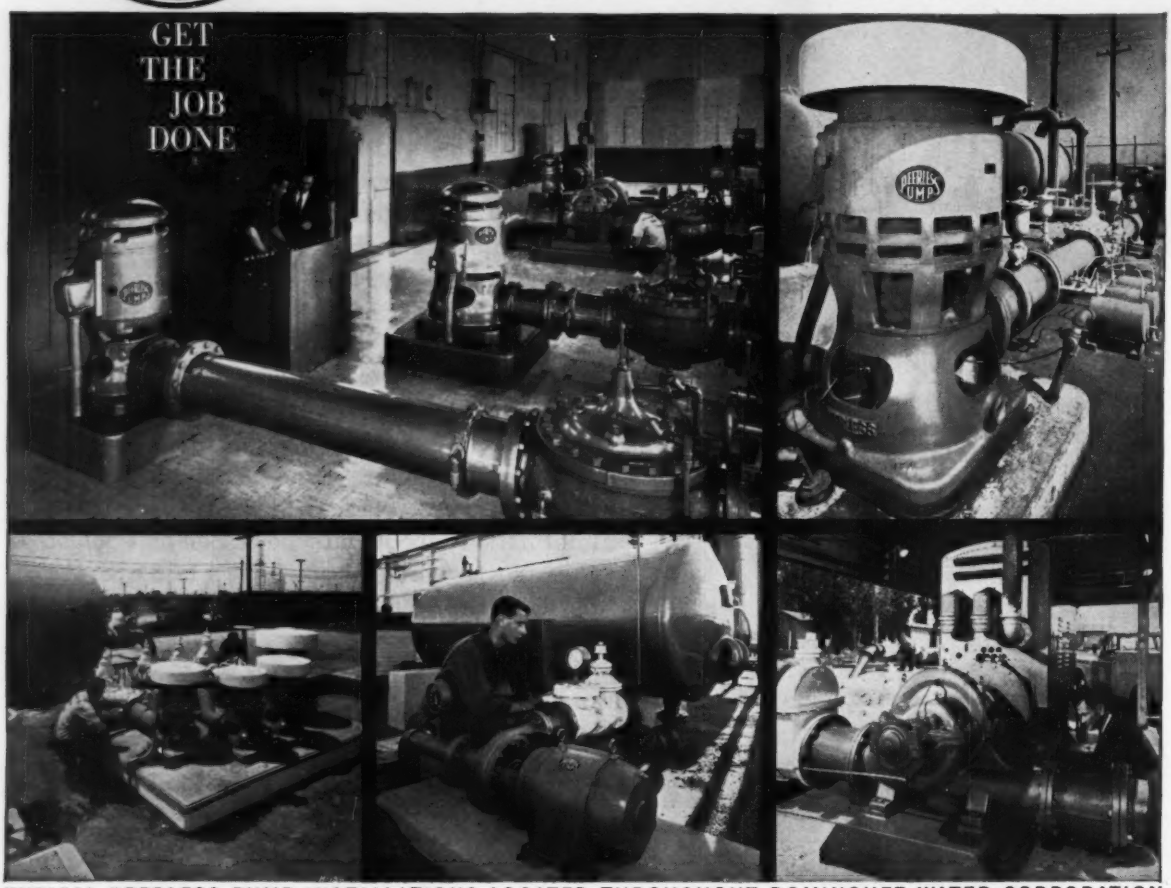

TYPICAL PEERLESS PUMP INSTALLATIONS LOCATED THROUGHOUT DOMINGUEZ WATER CORPORATION

BIRD'S EYE VIEW OF RESPONSIBILITY

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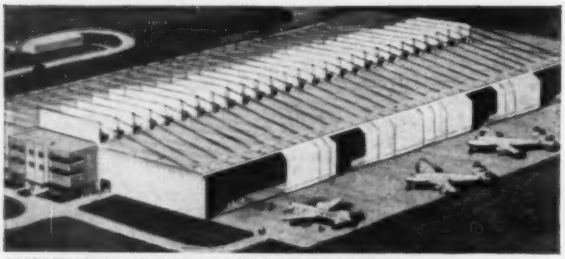
THE SHOPPING CENTER OF THE FUTURE—NOW!

In this shopping center of the future, the suspended roof would leave every square foot of interior space completely unobstructed. An artist's conception, yes — but this is no unattainable "dream building." Modern suspended roof techniques pioneered by Roebling make it practical and economical *now*.

Consider the down-to-earth advantages. Floor space for supports would become paying space instead. Merchandise would be handled, displayed and sold with new ease and efficiency. Customer traffic would move faster with fewer obstructions. Add low first cost and the prospect becomes even more alluring!

Suspended roofs are paying off handsomely in many types of buildings — plants, gymnasiums, airline terminals and hangars, auditoriums, stadiums and others.

Roebling's great experience with steel in tension enables it to take an active leadership in the suspended roof field. This experience is available to you. For information please call or write Roebling's Bridge Division, Trenton 2, New Jersey.



SUSPENSION ROOFS NOW AT WORK . . .
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UTICA MEMORIAL AUDITORIUM, N. Y. • Architects: Gehron & Seltzer, New York City • Associate Architect: Frank C. Delle Cese, Utica • Consulting Engineer: Dr. Lev Zetlin, New York City • Contractor: Sovereign Construction Company, Ltd., Fort Lee, N. J. • Roof Supporting Structure, Including Cables, Furnished and Erected by Roebling

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. . . . . Am-Soc Briefs

▶ ▶ New look for ASCE technical programs. . . . Probably the most far-reaching action to come out of the Annual Convention was the Board's decision to adopt the new concept for Society technical programs, developed by Executive Secretary Wisely and described in the September issue. The new plan, which will center programs around four major areas of technical interest, will be initiated at the Omaha Convention, where all papers will deal with some aspect of Water Resources. . . . The New York Convention and Board actions are reported in this issue.

▶ ▶ The Houston Convention, set for February 19-23, will be the last "old-style" Convention, with most of the Divisions presenting programs in their own fields. There is an important theme, however — "Planning and Building for Industrial Growth" — appropriate for a meeting in one of the nation's most spectacular boom cities and its No. 2 port city. The hospitality of Texans is legendary, and all who have ever attended a convention in the Lone Star State will want to go again. . . . There will be a story on the Houston Convention in the December issue, and the program in January.

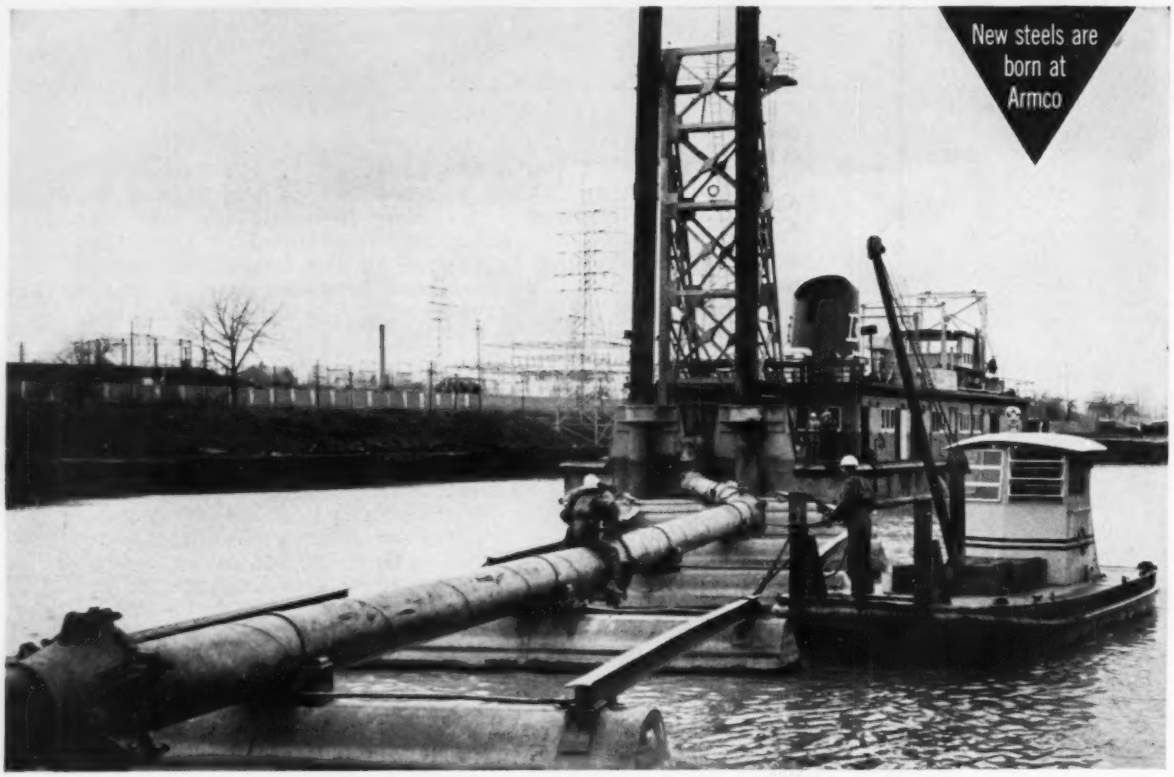
▶ ▶ Back to New York. . . . All Convention week we were happy to be showing off our new home to ASCE members and their families. It seemed to be the general opinion that the United Engineering Center is something pretty special. . . . At the dedication, on November 9, an engineering honor student — William L. Hallerberg, of the Missouri School of Mines and Metallurgy — will express the student view of the country's future needs and the engineer's prospect of filling them. He will share the platform along with such dignitaries as former President Herbert Hoover and Dr. Eric Walker, president of Pennsylvania State University.

▶ ▶ A million still to go. . . . About $1 million is still needed to complete the financing of the UEC. Though ASCE members were very generous in helping the Society meet its assigned quota, about two-thirds of the membership had no share in the fine gift. However, contributions may still be made, via the coupon on page 77, and will be very welcome.

▶ ▶ Sorry to belabor our new address, but Society mail should really be addressed to the United Engineering Center, 345 East 47th Street, New York 17, N. Y. Much of it is still being sent to the old (now wrong) address on 39th Street!

▶ ▶ In our fellow societies. . . . The boards of both the Institute of Radio Engineers and the AIEE have agreed to have their members vote on merging the two groups. If the consolidation is completed, the resulting society will be the largest in the world, with a membership of 150,000.

"...We get longer life from Armco Dredge Pipe"



To widen the Louisville-Portland Canal, near Louisville, Kentucky, dredge in background hydraulically removes sand, silt and rock through the Armco Dredge Pipe mounted on pontoons.

For strength, economy, durability — Steel

"Experience has proved that we get longer life from Armco Dredge Pipe, giving us more yardage at less cost," said Dunbar & Sullivan Dredging Co. of Detroit, who used Armco Dredge Pipe to handle 2½ million cubic yards of material in widening the Louisville-Portland Canal.

Dunbar & Sullivan utilized 1000 feet of 22-inch I.D. Armco Pontoon Dredge Pipe in 40- and 80-foot lengths. Pipe wall thickness was .438-inch. Ball joint fittings were welded to the pipe at the Armco plant.

Armco Dredge Pipe is made of a special steel, developed to withstand abrasive materials and rough service. It is supplied with various mill-fabricated fittings for dredging service. Write for informative folder. **Armco Drainage & Metal Products, Inc., subsidiary of Armco Steel Corporation, 6671 Curtis Street, Middletown, Ohio.**

ARMCO Drainage & Metal Products

do you know that

More than 60 percent of scheduled flights of American Airlines require less time in the air than the city-to-airport travel involved? In the past ten years flight time has been cut in half, but ground time has increased. This was one of the major problems discussed in Air Transport Division sessions at the Annual Convention, reported in ASCE news in this issue.

▪ ▪ ▪

The Trans-Canada Highway is nearing completion? The 5,000-mile highway, stretching across Canada from Newfoundland to the Pacific, will be the longest paved road in the world and one of the most scenic. It was begun in 1949, and the few remaining stretches are scheduled for completion by 1963. Though all sections are not yet paved, travel from coast to coast via the highway is now possible. Cost of the project is over $1 billion, with the government putting up about half the funds.

▪ ▪ ▪

Municipal water softening more than pays its way in detergent savings? In addition, it is by far the least expensive means of reducing water hardness. The *American Water Works Association Journal*, reporting the results of a survey of three Illinois communities, concludes that the average cost of softening 1,000 gallons of water containing 250 ppm hardness would be 61 cents if a commercially serviced home water conditioner were used; 18.1 cents if an unserviced home softener were used; and 5.3 cents if the local water utility softened the water. Figures are based on an average daily use of 27 gallons of softened water per person.

▪ ▪ ▪

Engineers are putting smoke to work? No longer is Pittsburgh the "Smoky City." At U. S. Steel Corporation coke ovens there, a special recovery process is being used to transform the smoke into about 145 pounds of chemicals per ton of coal burned in its conversion to coke. These by-products are being used in the manufacture of paints, explosives, insecticides, and nylon. Best of all, they make a special bone glue that hardens so fast a patient can move a recently broken limb within a few hours after the glue has been applied.

▪ ▪ ▪

Prodigious amounts of materials will be required to complete federal-aid highways up to the year 1972? According to American Road Builders Association surveys, the total will include 52,388,000 tons of steel; 270,000 tons of aluminum; 1 billion barrels of cement; 9.7 billion tons of aggregate; 43,200,000 tons of concrete culvert pipe; and 186,000,000 tons of asphalt—among other materials. Heaviest use of steel will be in structural shapes and for reinforcing; aluminum will go into extruded shapes and tubes, sheets and plates.

▪ ▪ ▪

General management is the best business track to top jobs? A Dun and Bradstreet survey of 250 of the nation's largest concerns shows engineering, law, and financial backgrounds as runners-up, in that order, in producing the greatest numbers of chief executives. General management is the background of one out of five of the men running our largest corporations, and one in every six has an engineering degree.

▪ ▪ ▪

California has endorsed installation of a "blow-by" device for new automobiles in an attempt to cut down air pollution? The State Motor Vehicle Pollution Control Board has approved the device (developed by AC Spark Plug) that is said to reduce atmospheric pollution from 25 to 35 percent per vehicle. It is attached to the engine crankcase. The cost will be around $9.75 at the factory, but might be as much as $50 if installed outside.

▪ ▪ ▪

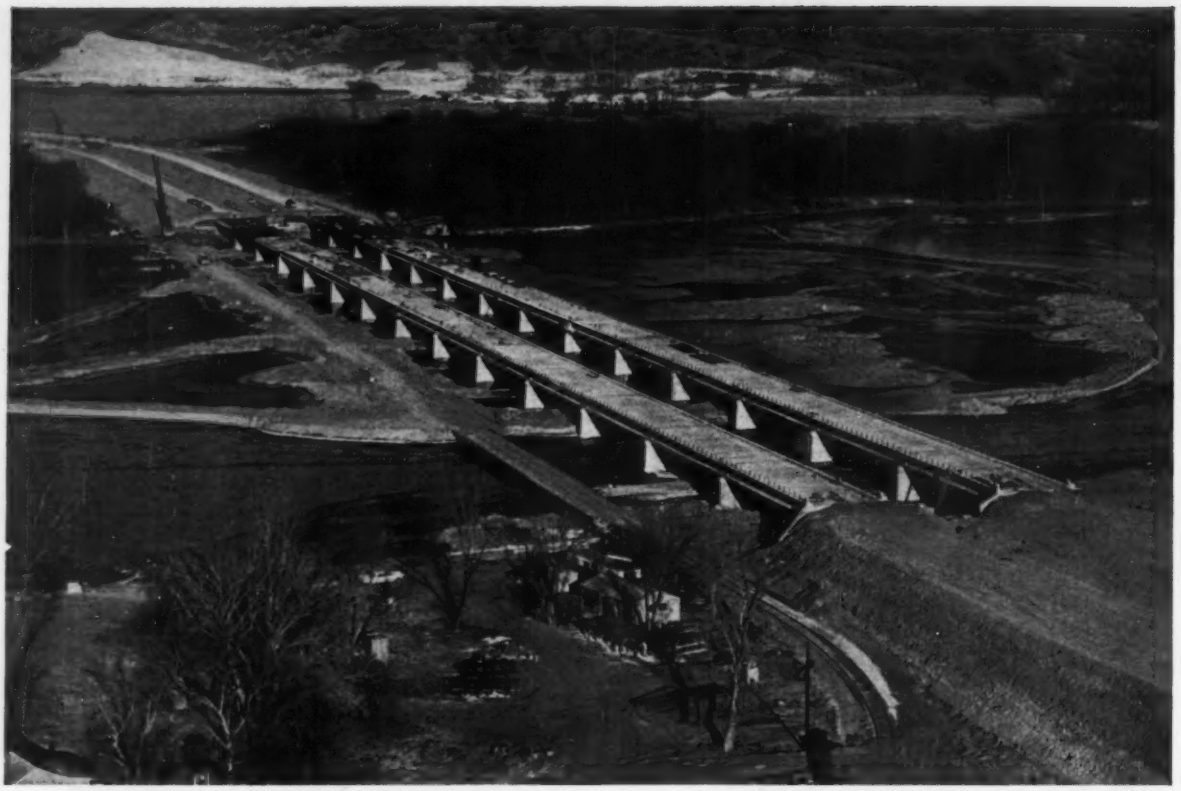
Use of A36 steel has been authorized for New York City buildings? According to the American Institute of Steel Construction, use of this new higher-strength steel in New York's public works and office buildings will save the city about $10,000,000 in the next five years. The higher yield point will allow increased design stresses using the same factor of safety.

▪ ▪ ▪

Pennsylvania is seeking to regulate stream temperatures? After a twenty-month study of state streams, a special committee to the Sanitary Water Board has advised controlling the discharge of hot water to streams—chiefly to protect aquatic life. To date, the committee reports, there is no evidence of damage from this source, "except in isolated cases. However, such discharge may create difficulty in the future." Pennsylvania is the first state to make extensive studies of stream temperatures.

▪ ▪ ▪

The number of women engineers in the U. S. is declining? In 1946 they comprised 2 percent of the total engineering force. Now they number less than 1 percent—perhaps 2,000, all told—the Society of Women Engineers estimates. Dr. Beatrice Hicks, first president of the SWE and head of a large engineering company, attributes the scarcity to "lack of encouragement from parents and teachers," rather than to lack of interest. In the Soviet Union, women supply 29 percent of the engineering force.



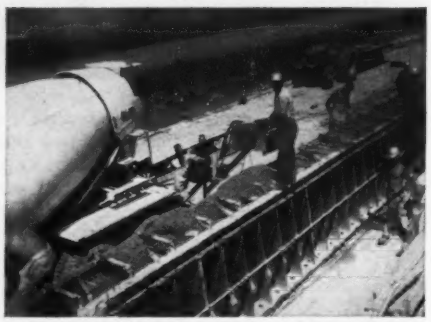
The twin trestle-type bridge is 1,542 ft in length. Each bridge carries a 30-ft-wide, two-lane highway, and has 14 spans of 110 ft. Each span has six prestressed beams—a total of 168.

CHOICE OF PRESTRESSED CONCRETE SAVES $100,000

The twin trestle-type bridges shown under construction here are part of an Interstate project carrying Route 80 across the Platte River between Lincoln and Omaha, Nebraska.

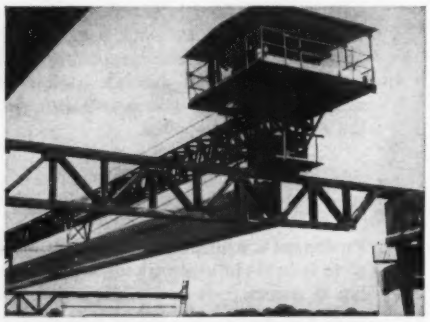
Prestressed concrete construction, selected after competitive bidding, resulted in a $100,000 saving on this 1½ million dollar project. There will be additional savings year after year because the new bridges will need a minimum of maintenance.

31,000 ft of 14-in. octagonal prestressed concrete piling were used in the pier foundations. The 168 prestressed beams required, each 110 ft long and weighing 56 tons, were both pre-tensioned and post-tensioned.



Prestressed concrete beams were cast on an assembly line basis in collapsible metal forms in a bed 350 ft long, 38 ft wide, with movable steel abutments at each end. Here ready-mix concrete is being placed in forms by conveyor.

Prime Contractor: Massman Construction Company, Kansas City, Mo. Design: Nebraska Department of Roads, Lincoln, Neb. Prestressed Beams produced by Nebraska Prestressed Concrete Co., Lincoln, Neb.



Beams were shipped 35 miles to bridge site by rail and installed on the piers by an ingenious contractor-built gantry.

LONE STAR PORTLAND CEMENT

Lone Star Cement Corp.
New York 17, New York

From his inaugural address as President of ASCE, at the Annual Convention in New York, October 18, 1961

THE ERA UP TO "Metropolis 1980"

G. BROOKS EARNEST, President ASCE
President, Fenn College, Cleveland, Ohio

The induction of the new ASCE officers installed at this time will be remembered for one important advancement of the Society—that is, the move to the splendid new quarters in the United Engineering Center. This handsome center is fittingly located in proximity to the United Nations.

However, my text here is not concerned with this kind of advancement, important as it is, but rather with the advancement of the scientific and technical interests of the Society. This text is:

At present there is a delayed and insufficient assimilation of new knowledge from research into application.

This statement, whether correct or incorrect, corresponds, within certain limits, to my own impression, and it comes from an authoritative source—a report from a hard-working subcommittee considering the long-range objectives of the Society.

I do not doubt that in civil engineering the best practicing engineers and teachers are constantly assimilating the new scientific and engineering knowledge called for in their work. It is the mark of the good professional that learning never ceases and never even slows down.

The question, however, is concerned with insufficiency and delay in assimilating new knowledge. The answer, I think, is that, so far as single minds can assimilate the materials available, there is little insufficiency, but the sheer bulk of the new knowledge in published papers and books is causing delay. These American books and papers, I've heard it alleged, are more quickly, more widely, and more appreciatively read in some of the other countries of the world than here.

I can believe this. It is well known in academic circles that there are whole lines of virtually completed scientific investigations and tested formulations of principle crying for engineering applications. What engineers we have are good enough but we do not have enough of them. Last year we graduated fewer than 35,000 engineers. Those of us who have taken the trouble to glance behind are agreed that we may soon be overtaken by other countries.

A new and vigorous meeting program

The immediate problem is how we, specifically the American Society of Civil Engineers, can help reduce delays in applying new knowledge. This question led me to inquire into just what the 14 Technical Divisions of the Society are doing. I did not have to look far.

Secretary Wisely delivered the facts and some suggestions at the Des Moines Technical Procedure Conference last spring. His views were later incorporated into his article, "A New Concept for Technical Programs in ASCE," in the September 1961 CIVIL ENGINEERING, page 44. This proposal by Secretary Wisely has just been adopted by the Board, and is now the Society's new and vigorous program for national technical conferences.

The first change is to hold four basic conferences a year, one for each of four technical areas defined as Transportation, Environmental Engineering, Structural Engineering, and Water Resources. These four broad areas include with very specific relevancy the interests of all 14 Technical Divisions.

The second change is to hold periodic divisional and specialty conferences on timely subjects. These would present opportunity for highly specialized papers and discussions supplementing the basic conferences. The dangers and the necessity of specialization are of course well known. We must avoid the one and serve the other. The professional civil engineer is more and more becoming a specialist because specialists, properly coordinated by a generalist, do better work for clients and employers. This holds not only for our profession, but for all professions. Our specialty conferences should have a high status and be in fact national meetings.

The third change is to hold a single annual convention combined with one of the national technical conferences. In addition there would be discussion of matters of the widest professional interest. We would conduct our annual business and elections, bestow our annual awards and honors, hear addresses by national figures in government, industry, and other professions. We would discuss and act upon measures concerned with conditions of practice. We would hear special lectures of general and topical interest from national and international authorities. There would be sessions for papers arranged by the Technical Divisions.

The fourth change is to increase participation in joint conferences with other engineering and scientific societies, national and international. The learning and practice of engineering in all fields are becoming increasingly interdisciplinary. This results not only from interdependence among the various fields of engineering, but also from the dependence of modern engineering on the basic sciences of mathematics, physics, and chemistry. This dependence is rapidly being extended into the life sciences, the behavioral sciences, and the humanities. Eco-

nomic, political, and human factors, as experienced engineers know, are often major considerations in the design of devices and structures. The importance of joint conferences with other societies for the proper assimilation of new knowledge can hardly be overestimated.

The ASCE Constitution states that the objective of the Society shall be the advancement of the science and profession of engineering. The carrying out of this objective demands that the Society endeavor at all times to render a better service, not only to its members, but to mankind. There is no doubt in my mind that this new concept for technical programs will do just this and provide a much more effective vehicle for the communication of civil engineering knowledge.

Assimilation of new knowledge

These reforms, taken together, would constitute an organizational structure within which new knowledge could be assimilated by our membership with more convenience and dispatch than now prevails. Yet when this organization is established, will new scientific and engineering knowledge in fact be assimilated into practice more rapidly? My entire experience as an educator tells me to doubt this. We have so far dealt only with the form, not the substance.

Assimilation of new knowledge is after all an educational problem. For engineers it is an educational problem at a very high and specialized level. At this level of education, quality has, I think, an absolutely crucial importance. Without high quality, no technical program is going to be successful in the Society. No professional engineer would ordinarily cross the street to hear a paper on an unpromising subject by an unknown expert—not even if the paper is given during a national convention and he happens to be at the convention. We know all this now.

Quality in our technical programs has two aspects, the fact and the appearance. We must have quality in fact if we are to benefit our membership. We must have it so plainly and so well advertised that appropriate fields of our membership will find it expedient to drop whatever they are doing, take the time and go to the expense of coming to hear the program. This is a very large order, and I shall outline the requirements for filling it. This outline, I am glad to warn everybody, is the only easy assignment connected with the task.

When the program committee of a Technical Division of our Society sees a line of new knowledge in its field deemed worthy of presentation in a program of papers, it should follow principles easily stated but hard to carry out. It must find distinguished papers on promising topics by well-known and well-recommended experts. It must locate the experts and persuade them to undertake the job. This will take time, hard work, and probably money.

Getting the best papers

To assure promising topics within the line of new knowledge, the committee must collaborate with the experts on the formulation, order, and relation of topics. This will take time, hard work, and probably money.

To get distinguished papers, it is necessary to have them submitted in advance for checking with at least one other authoritative expert for each. More time, hard work, and probably money.

The selection and arrangement of the time, locale, physical facilities, quarters, and logistical requirements for the meeting at which the program is to be presented are simple matters but they also will take time, hard work, and certainly money.

So will publication of the papers, though here I think savings can be hoped for. Outstanding papers, generally speaking, are shorter and require little editing. The technical papers developed in the manner described would surely be fewer. Our publications should become less expensive and more distinguished.

Another way to give more engineers the opportunity to avail themselves of the contents of distinguished papers and ensuing discussions by learned audiences would be to record such proceedings on 16-millimeter film. These films could be made available, perhaps for a reasonable compensatory fee, to engineers and engineering organizations. If the papers are distinguished, their authors well known, the topics promising, we could hope for the eventual recovery of most of the cost of production and filming. Here I am thinking of the theme of this convention, "Metropolis 1980."

The procedures here outlined for originating and distributing our technical programs, though time-consuming, laborious, and expensive, may seem fairly straightforward and basically simple. Let me warn that nothing in them is straightforward or simple. Few established new lines of knowledge are likely to correspond to the interests of just one of our Technical Divisions, nor even to a single technical area as now defined by the Board.

Take as an example—and only as an example—the comparatively new knowledge about non-military uses of nuclear explosives for power production, for mining, and for the excavation of harbors, reservoirs, and roads. With the resumption of nuclear testing, this knowledge will increase and certainly involve three of our four technical areas—Transportation, Structural, and Water Resources, as well as 12 of our 14 Technical Divisions. At least 12 committees, then, would be concerned in setting up the program. This is the sort of thing that causes problems and delays in the best conceived organization. The 12 committees could, at best, be reduced to a single committee of 12, so that each Division would have one representative.

The committee would wish to correspond or talk with the people who have actually explored uses of nuclear explosions. The wish would lead them to the Plowshare Project of the Atomic Energy Commission, the Livermore Branch of the University of California Radiation Laboratory, and the Rainier Project, which managed the first underground nuclear explosion, in Nevada in 1957.

This inquiry would uncover the scientists and engineers with several large utilities engaged in assessing the potentialities of underground nuclear explosions for turbine generator production of electrical power at a cost of the order of half a cent per kilowatt-hour.

Can we do it well?

The diversity of leads in this comparatively narrow field of new learning barely suggests the tasks involved in building technical programs of high quality for the quicker assimilation of new knowledge into practice. If our Society should decide that the central task of our Technical Divisions is not worth doing on the ground that we cannot do it well, I should oppose the decision until satisfied that we really cannot do it well—and I shall remain hard to satisfy on this point.

Formulating promising topics presenting in some completeness a line of new knowledge, finding well-known and well-recommended experts, and securing distinguished papers from them, must often take our committees to the ends of the earth. It should not take them to the end of their patience. It is surely not beyond their intellectual resources.

If it lies beyond our present resources of time and money, we must increase those resources. I paraphrase the great George Washington: A task, if worth doing at all in this new era—leading up to Metropolis 1980—is worth doing well.

Campus of Mexico's National University is seen from the Engineering School laboratory. Main library is at left, School of Philosophy at right, and domes of the laboratory in foreground.

A civil engineering boom in Mexico

HERBERT A. SAWYER, JR., F. ASCE
Professor, Civil Engineering
University of Connecticut
Storrs, Conn.

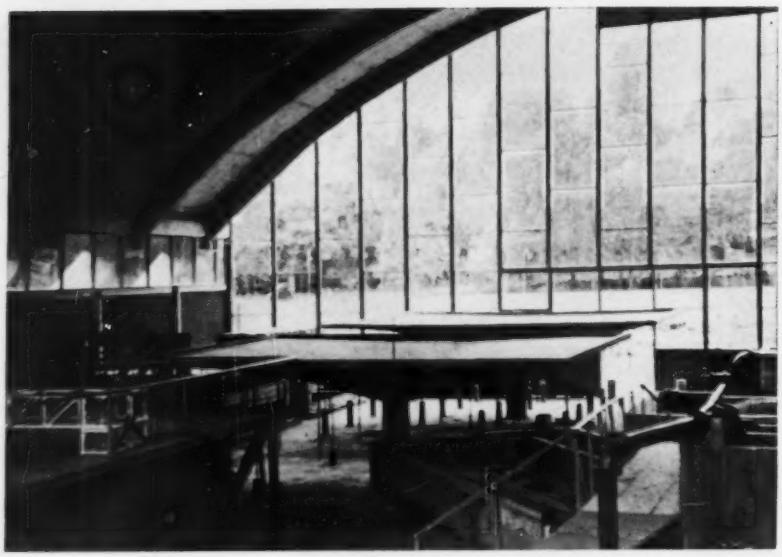
In Mexico, civil engineering is a field of tremendous challenge. Mexicans are meeting this challenge with magnificent achievements, both in engineering practice and in the education and research that are basic to sound practice.

Many aspects of the challenge are apparent soon after one crosses the border on the three-day automobile trip to Mexico City via the Pan-American Highway. In the dry season, beds of what could be mighty streams reveal the shortage of water which afflicts five-sixths of Mexico. And the kindly warmth of the climate prevents the accumulation of snow which provides continuous flow for the streams of more northerly semi-arid areas of the continent. Except in the lush tropical lowlands, an adequate water supply for man and his crops is a critical problem, not to mention the problem that a relatively dense population and dry stream beds pose to the sanitary engineer. Apparently, semi-arid land in Mexico supports a much higher population than similar land in the United States.

With these natural conditions, if the term "backward" is used for rural Mexico, it should be used with sympathy and with recognition of the great progress made in recent years. For example, an anti-malaria campaign, mostly financed by Mexican funds, reduced the incidence of the disease from 136.7 per 100,000 in 1955 to 4.3 in 1959.

Good roads in rugged terrain

After the first day of travel below the border, the tourist's eye is treated to the profiles of unbelievably sp[illegible] and jagged mountains which have not known the softening erosion of millenia of rainfall. Yet the road proceeds and is soon surrounded by range after range of these mountains. The Pacific-Ocean side of our continent is rugged from top to bottom, but in relatively narrow Mexico and Central America



The Structures and Hydraulics Laboratory is part of the Institute of Engineering, in Mexico City.

this ruggedness seems to be correspondingly concentrated. Mexico has led the way for Latin America in constructing its 1,600-mile portion of the Pan-American Highway, accomplished with its own engineering and financial resources. Although the lines and grades of this early section are not exceptional by present standards, the road remains a magnificent engineering achievement considering the terrain.

Mexico's present highway standards can be observed on the 250-mile trip from Mexico City to Acapulco over equally rough terrain. This road, superior to any mountain road I have seen, was constructed for a minimum allowable speed of 40 mph, although rock cuts up to 50 ft deep were necessary. Fully as significant to Mexico's internal development are the many evidences of a rapidly improving secondary road system.

Even railroads offer a challenge in Mexico. The Pacific Railroad Company, established by the government in 1954, is completing a new 570-mile line called the Chihuahua and Pacific Railroad, to run from Ojinaga (across the Rio Grande from Presidio, Tex.) to Topolobampo on the Gulf of California. It will shorten the travel distance between the Midwest and Mexico's Pacific Coast, and will open a highly scenic region to tourists. Complete renovation of an older 1,200-mile section of the railroad has already induced an annual traffic of 9,000 carloads of fresh fruits and vegetables to United States markets.

Detail of model of the port of Manzanillo on the west coast of Mexico, at the Institute of Engineering, a part of the National University in Mexico City.

The urban challenge

The urban challenge to the Mexican engineer, and his magnificent response to this challenge, is of course most evident in that vast, cosmopolitan hub of Mexican culture and commerce, Mexico City. Considering a 3-million-population figure of 1950 vintage, it is surprising to learn that the greater city or Federal District now has over 5 million people, explained by an annual growth rate of 6 percent. It is now the second largest city in this hemisphere, and it exceeds Mexico's second city, Guadalajara, by a factor of seven. Mexico itself has recently had an annual growth rate of 3.4 percent, considerably higher than ours. But booming Mexico's productivity, unlike that of several other Latin-American countries, has more than kept pace by increasing 6 percent annually.

The new buildings recently constructed to absorb Mexico City's growth have been designed for as severe a combination of subsoil instability and seismic loading as is found in any large city. Yet they are not restricted in size (the Latinoamericana Tower is the tallest in Latin America) or architectural beauty.

The impact of Mexican architecture reaches its climax on the southern edge of the city, at the campus of the National University. The University was formerly housed in a somewhat scattered assortment of downtown buildings, and because of this location suffered from too much involvement in every shift of municipal and national political winds. A legally guaranteed political autonomy was achieved after World War II, when a new "University City" was constructed on what had been lava-bed "wastelands." From the purely physical standpoint this campus must rank with the foremost of the world. Building after building of monumental size and strikingly beautiful form and color occupies its proper space on an extremely well-planned and accessible campus.

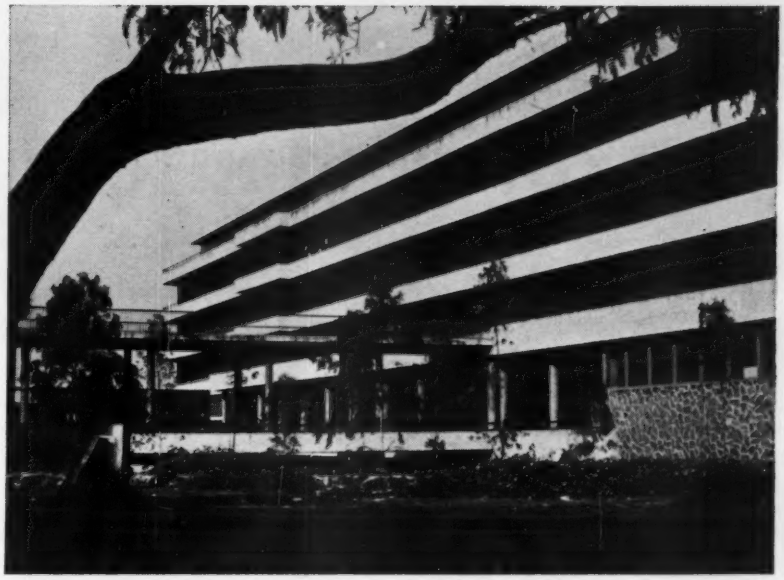
Human labor and care

The degree of artistic and engineering creativeness shown by these buildings and others throughout Mexico is all too rare in the States. Why? One wonders if the appeal of so many Mexican structural forms and colors is not

their strong evidence of human labor and care. In Mexico it is economically feasible for a mason to spend hours in the loving shaping of a building block or days on the careful placement of pieces in a mosaic design created by a great national artist, because his wages are about one-fourth the salary of a university instructor!

In contrast, our severe blocks of endlessly repeated machine-made panels and glass look as if they have scarcely been touched by human hand —a true reflection of the value placed by our economy on human labor. Of course, if cheap labor means greater freedom for human creativeness in architecture and engineering it also means a lower standard of living, and the trend in Mexico is toward our standards. But perhaps Mexicans realize more clearly than we do that there are two sides to this question, and so they are not in quite so much of a hurry.

Another factor allowing greater freedom is Mexico's climate, which permits the use of beautiful native igneous rocks, brick, or concrete aggregates which would deteriorate rapidly in most areas of the States. The dryness that limits agricultural and industrial activity favors these materials, as does also the even temperature. For example, the daytime temperature of Mexico City ranges from 65 to 80 deg the year round, and light early-morning frosts occur only a few times a year. Hence, Mexico abounds in well preserved remains of prehistoric Indian stone and brick work, including the Egyptian-scale pyramids of Teotihuacan, as well as Spanish-colonial buildings and cathedrals of the sixteenth century, antedating our first settlements.



The Engineering School of Mexico City's National University is the largest engineering school on the continent, possibly in the world. One of its buildings is seen here.

Continent's largest engineering school

The activities of the National University seem to match its physical plant. Of its University City enrollment of 42,500 students, 6,950 are in engineering, making it the largest engineering school on the continent, and possibly in the world. (Mexico has other much smaller engineering schools in Mexico City, Guadalajara, San Luis Potosí, and Monterrey.) Furthermore, approximately 5,200 of these students are in civil engineering!

Only 8 percent of the students entering engineering survive the five-year curriculum and get professional degrees. Some other students complete the three-years-plus-special-subjects required to become a surveyor or geodesist. Requirements for the professional degree include, besides the five years of college, a professional thesis, six months of "social service" or practice connected with a public works program, and a professional examination. With this degree one may practice anywhere in Mexico, except that registration involving more rigorous requirements is necessary for responsible structural practice in the Federal District.

Civil engineering also dominates the engineering graduate study and research of the university. The four-year-old graduate school, enrolling over 100 students, offers work in structures, soil mechanics, hydraulics, sanitary engineering, and ground transportation, with degrees at the Master's or Doctoral level. Some individual graduate courses are offered in electrical, nuclear, and mechanical engineering.

Research activities and facilities are administered separately by the Engineering Institute, although much the same personnel is involved. The Institute moved into two new buildings in 1960, one housing offices and small laboratories and the other housing large laboratories under a beautiful reinforced-concrete ribbed barrel-arch roof.

The more than 40 projects currently being investigated by the Institute in five major areas reveal the scope and range of its work. Sample projects in each of these areas are:

Sample research projects

1. Earthquake engineering. Dynamic torsion in multistory buildings with eccentricity in plan, dynamic analysis of rigid-plastic systems such as rockfill dams.

2. Structural mechanics and materials. Numerical computation of design coefficients for slabs under line loads and slabs supported on two and three sides, experimental comparison of long-term deformations of a simply reinforced and a prestressed-edge hypar shell.

3. Soil mechanics. Effect of rate of loading on strength of soils under triaxial loading, effects of soil conditions on foundation failures from the Coatzacoalcos earthquake.

4. Hydraulics. Experimental and analytic studies of spillways combined with aspirating siphons, design theory for multiple-curve canals with supracritical flow.

5. Economic studies. Feasibility of navigation along a Mexican river, optimum designs for multi-purpose reservoirs.

Especially encouraging is the construction industry's recognition of the importance of the Institute. For example, the series of lectures I delivered at the Institute was sponsored by Fundación Ingeniería, A. C., a foundation supported by contractors for the promotion of research and education in civil engineering. Contractors north of the border please note!

If we can associate more closely with our Mexican colleagues and their challenging frontiers, all will gain. The stimulation to us and what we will learn will more than balance whatever we may give.

Engineers and/or computers

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King and Gavaris, Consulting Engineers, New York, N. Y.

Introduction

Until the advent of electronic computers, engineers had reason to regard themselves as indispensable factors in the design of structures. Without getting involved in semantics and what is meant by "design," we can say that while engineers may still be indispensable, much of their brain power can be efficiently supplanted by electronic computers.

Just as the introduction of steam power to replace the human hand brought about the Industrial Revolution, so the development of electronic impulses and computer logic to replace the human brain is leading to another revolution, an Electronic Revolution. The implications of this revolution are not yet completely understood by members of the engineering profession. The complete obsolescence of much of our engineering personnel can be one immediate result—unless what is occurring is recognized.

Dr. Thomas Stelson, M. ASCE, Head of the Department of Civil Engineering at Carnegie Institute of Technology, shows an educator's awareness of the impact of computers on the engineering profession. In his article, "Education for Oblivion," in the April 1961 issue of the *Carnegie Alumnus*, he states:

"One aspect of engineering practice which has had a tremendous impact on education and engineer obsolescence is the widespread use of high-speed electronic digital computers. Broad areas of graphical and computational development have become worthless overnight. For example, in the civil engineering profession the moment-distribution technique for analyzing complex, statically indeterminate structures is a high-water mark in the development and refinement of computational ideas and methods. It enabled an engineer with slide rule and pencil to solve complex systems of hundreds of equations and hundreds of unknowns. From the development of the method in the late 1920's until its peak in the early 1950's, this computational system moved succes-

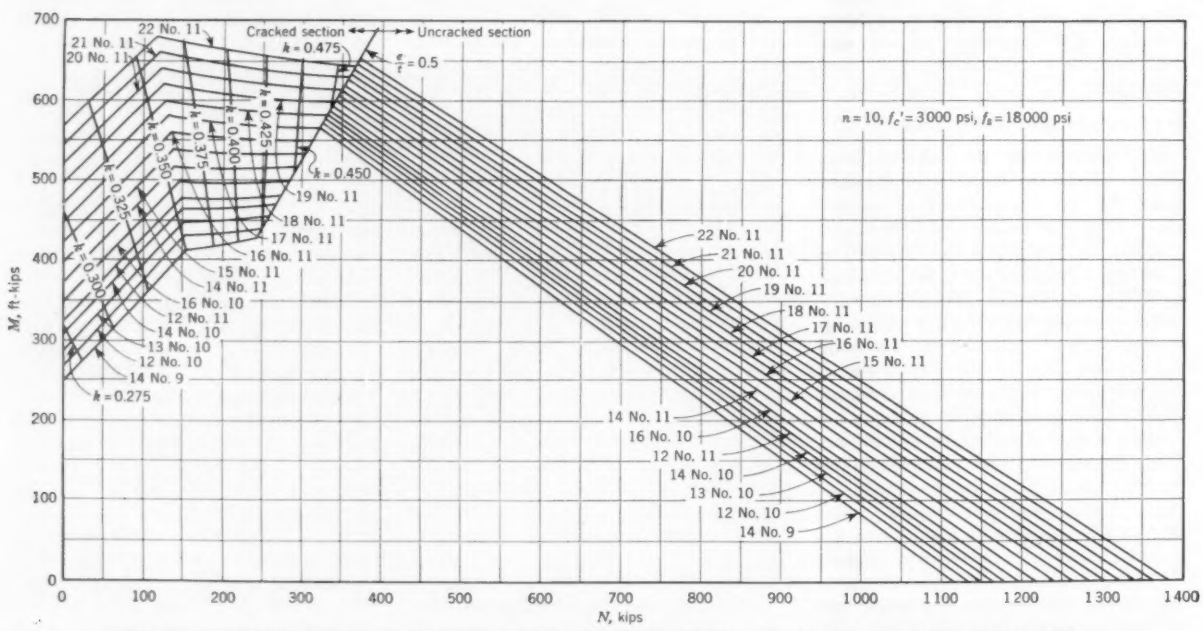


FIG. 1. Moment-load chart for reinforcement according to 1957 specifications of American Association of State Highway Officials, 100 percent basic unit stress, for a 3-ft 6-in. reinforced concrete column (eccentrically loaded, spiral).

Typical four-span composite stringer highway bridge on a horizontal and vertical curve is example chosen for this discussion of bridge design by use of Royal McBee LGP 30 computer.

sively from the research level to the graduate study level, to its inclusion in virtually every undergraduate civil engineering curriculum. Engineers, who for years developed their ability to handle these techniques, are now displaced by high-speed computers. Unless they have the capacity and interest to grow in other directions, they are faced with the prospect of being obsolescent and of no real value to their employers or to society."

Yet even this recognition of the changing pattern of engineering practice doesn't begin to delineate what to expect in the near future. While the major effort of our consulting firm is in bridge and highway engineering, this discussion will include some of our experience, and progress, in computer programming in related fields.

This article is being presented in three parts, plus the introduction. Part I is devoted exclusively to highway bridge structures, Part II to major features of highway design, and Part III to isolated design problems that occur periodically in every consulting office, either as part of a larger project or as entities in themselves. Each part will be developed to show how our programming has reached the point of partial or total integration within its field. Our computer is a Royal Precision LGP 30, marketed by the Royal McBee Corp.

With regard to bridge structures (Part I), we are now at the point where the design computations for an entire bridge of the conventional stringer or girder type can be completed by one program in a matter of a few hours. This type of programming, which we will designate as an integrated program, is now being prepared for multi-span, simple, composite stringer bridges; multi-span continuous girder bridges; multi-span continuous and cantilever (combination) bridges.

In the field of soil mechanics (Part III), an integrated program has been completed for the analysis of the stability of slopes by the Swedish circular-arc method. This program has been integrated in its final form to give the total solution irrespective of types of soil, number and irregularity of soil layers, irregularities of the existing and finished ground profile, superimposed live and dead loads at any location, earthquake and hydraulic loadings.

In the field of hydraulics, a similar process of combining isolated hydraulic-flow programs into one integrated program for entire networks is taking place. Wherever an engineer is now sitting at his desk and using a slide rule and desk calculator to compute fairly complex solutions to engineering problems that follow design paths controlled by standard specifications, design parameters or even assigned logical limits, it is only a question of time before most or all of his computations will be done by electronic computers.

While computer operation has advanced rapidly in both theory and practice in the four years our firm has been using a computer, an adequate realization of its tremendous range has come about only recently. In the beginning we treated the computer as a simple tool and wrote programs of limited scope for individual problems. As we became increasingly aware of its tremendous capabilities in contrast to the limited nature of our applications, we revised or rewrote the programs to encompass total solutions for any one type of problem. An example of this stage of development is the preparation of design charts from computer runoffs for the final solution of eccentrically loaded, circular, reinforced tied or spiral columns, as shown in Fig. 1. Further development soon led to the incorporation of programs for individual problems into larger components so that an entire section of a design was handled by one program.

Part I. Highway Bridges

One phase of civil engineering that has shown itself particularly adaptable to computer programming is the analysis and design of bridges. Controlled by the fairly rigid specifications of the AASHO, each segment of a bridge structure travels a narrow design path—once the type, size and location of the structure have been determined. It is this design path that can be programmed. And once the program has been prepared, it becomes the basis for solutions for all similar bridges.

The best way to understand what computer programming means to us as engineers is to study a sample bridge and trace the remarkable reduction in design time that has taken place—from 5 man-weeks to 21 man-machine hours. And it is believed that a bridge can soon be designed in 4-man-machine hours or less.

Using a standard four-span composite stringer highway bridge on a horizontal and vertical curve as our example, we find that it has four main design components: (*A*) general alignment and geometry, (*B*) roadway stringers, (*C*) piers, including foundations, and (*D*) standard abutments, including foundations.

A comparison of design time presented in Table I shows how radically the computer has changed our concept of this factor. One interesting point, not apparent from a study of the table, is that the design of a similar four-span structure of more complicated geometry and structural fea-

TABLE I. Comparison of design time for a sample bridge by manual and computer methods

Components	Description	Manual Computation (Man-days) Design	Checking	Component Program (Man-machine hours) Data	Machine	Fully Integrated Program (Man-machine hours) Data	Machine
A	Align. and geom.	5½	3½	2	1½	2½ hr. (estimated)	1½ hr. (estimated)
B	* Roadway stringers, 4 spans	2½	1	1	1½		
C	Piers (3)	6	5	9	3		
D	Abutments (2)	½	½	2	1		
	Subtotals	15	10	14	7		
	Totals	† 25 man-days		21 man-machine hr.		4 man-machine hr.	

* The design of the roadway slab is neglected in this discussion. However, a program has been written and a design chart prepared that gives the A_s for every spacing of stringer up to 10 ft 0 in. and every skew up to 60 deg.

† A figure of 25 man-days assumes that each of the three piers requires a design and that each of the four spans will require a design for one typical interior stringer and one typical exterior stringer. This total figure of 25 man-days may be slightly reduced by the use of approximations, manually prepared design charts, and tables and short-cut approximations normally used in most design offices.

Printout 1

Work Point No.	Station	Coordinate (N)	Coordinate (E)	Dist. ℄ to Ext. Fascia	Dist. ℄ to Int. Fascia	Tang.Dist. (T)	Tang.Offset (S)
Theo. Sta. Line No."0"							
	254+91.359	0942696.150	0622769.766	--	--	0	0
Working Line No.							
1	253+94.728	0942612.088	0622817.427	00018.130	-00018.133	-00096.631	00000.720
2	254+65.728	0942673.920	0622782.531	00018.181	-00018.184	-00035.631	00000.051
3	255+26.728	0942736.736	0622752.011	00018.227	-00018.230	00035.366	00000.096
4	256+18.730	0942805.845	0622706.044	00018.299	-00018.303	00127.358	00001.250
5	256+88.230	0942865.159	0622668.825	00018.357	-00018.361	00196.836	00002.987

Work Point No.	Skew Angle Wk.- Rad.L.	Bearing of Radl. Line
1	014°-07'-31"	N 60°-52'-29" E
2	014°-45'-39"	N 60°-14'-51" E
3	015°-17'-20"	N 59°-42'-31" E
4	015°-06'-14"	N 58°-53'-46" E
5	014°-41'-04"	N 58°-16'-56" E

tures might increase the time for manual computation by as much as 25 percent, but would have no material effect on a computer solution.

The concept of component programs and their eventual inclusion in one fully integrated program can best be illustrated by analyzing each component program.

Component A. General bridge alignment and geometry

With known data of horizontal curvature, vertical profile, location and direction of center lines of bearings, structural dimensions, and width of structure, the entire bridge geometry is produced in one operation. While the output is divided into three tables, the program is an integrated one and the computer goes automatically from one table to the next.

Printout 1 gives: (*a*) station and coordinates for all working points or working lines; (*b*) distances from centerline of bridge to exterior fascias at each working (bearing) line; and (*c*) geometry of all working points in the form of tangent distance, *T*, and tangent offset, *S*. All the information supplied by Printout 1 is given in the sketch, Fig. 2. The known data are boxed for illustration, while the computer supplies all other figures, as illustrated by the runoff in Printout 1.

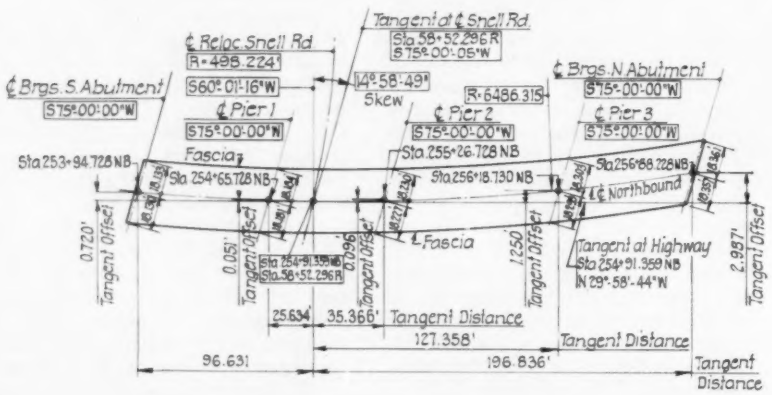
Printout 2 gives: (*a*) station of intersection of each stringer with centerline bearing (working) lines; (*b*) theoretical grade elevation at these stations; and (*c*) elevations of bottom of masonry plates for all stringers.

A typical printout for the first span of our sample bridge shows the simplicity of the format. See Printouts 2 and 3.

Printout 3 gives: (*a*) intersecting angle of each stringer with each centerline bearing (working) line; (*b*) station and elevation of the mid-point of each stringer; and (c) vertical-curve cambers of each stringer.

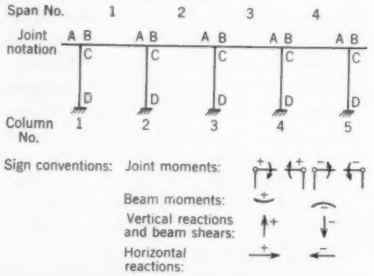
Component B. Roadway stringers

With known slab dimensions, spacing and span of stringers, initial miscellaneous dead load exclusive of slab and stringer (for example, bracing and diaphragms); additional dead load after composite action (wearing surface), the entire design is computed by machine. A typical example of the design of one stringer in the first span (Printout 4) shows that everything required for the contract drawing is presented by the machine printout.



◀ **FIG. 2. Information on alignment given in Printout 1 is sketched. Known data are boxed.**

▼ **FIG. 3. Joint notation and nomenclature for pier-bent program.**



Component C. Piers

Utilizing the method of moment distribution, the pier-bent program is capable of handling any pier, irrespective of column heights, beam span and shapes, skews to bridge centerlines and cantilever overhangs. (See Paper No. 1854 by Dr. Charles P. C. Tung, ASCE *Proceedings*, November 1958.)

Individual effects of all standard AASHO loadings are automatically combined in the computer to give the maximum design value for the standard loading groups as tabulated under Section 3.4.1 of the AASHO Specifications. Input data required by the computer are: (*a*) number of spans, (*b*) sizes and shapes of beams and columns, (*c*) span lengths and column heights, (*d*) loads, and (*e*) loading groups required (AASHO 3.4.1). See Fig. 3 for nomenclature.

Individual loadings are analyzed and automatically combined into the required groupings, and the computer returns the final design results in two parts which consist of the following (see Printout 5):

Part 1. Final design values of all joint moments
Final design column base reactions
Part 2. Final design values of all moments and shears at tenth points of beam

Once the analysis of the pier bent is completed, the only work remaining is the solution of the reinforcing steel for the beam cap; reinforcing for the columns; and the size, shape and reinforcing for the footings. Since these solutions were not completely integrated, final design charts were prepared for each of the non-integrated parts. A typical example of one of these is the moment-load chart for eccentrically loaded reinforced concrete columns. As can be seen from Fig. 1, we enter the chart with the value for N (load) and M (moment) taken from the computer runoff and pick off the final reinforcing-steel design for the column.

Another design chart is used to select the reinforcing steel for the beam cap. The approach to the final solutions for the footings is similar. Because of the complexity of foundation conditions, design charts were prepared for soil bearing values ranging from 1½ tons per sq ft to 5 tons per sq ft for isolated or spread footings. The designer must first determine what type of footing and soil bearing pressure is required and then choose the size, shape and reinforcing from the required design chart. If the footing is rectangular with combined bending and axial load, the program from which the charts were made is divided into two parts; the computer

Printout 2

Stringer No.	Station	Theo. Grade Elevation	Cross Slope Correction	Depth of Bdwy.& Str.	Elev.Bottom of Stringer	Depth of Bearing	Elev.Bottom of Mas.Plate
Bearings No. 01							
1	253+98.755	1143.3160	-0000.1241	0003.8474	1139.3445	0000.3750	1138.9695
2	253+96.738	1143.2486	0000.1254	0003.8941	1139.6800	0000.3750	1139.1660
3	253+94.728	1143.1806	0000.3750	0003.8941	1139.7215	0000.3750	1139.3465
4	253+92.718	1143.1117	0000.6246	0003.8941	1139.9022	0000.3750	1139.5272
5	253+90.716	1143.0422	0000.8742	0003.8474	1140.0688	0000.3750	1139.6938

Printout 3

Stringer No.	Str. Angle Dn-Sta.End	Str. Angle Up-Sta.End	Stringer Length Ft.	Station of Mid-Point	Elev. of Mid-Point	Av.Elev.of End Brgs.	V.C.Camber in Inches
Span No. 1							
1	014°-26'-20"	014°-26'-20"	070.48352	254+34.086	1144.2177	1144.0781	1.6250000
2	014°-26'-20"	014°-26'-20"	070.48352	254+32.023	1144.3148	1144.2755	1.6250000
3	014°-26'-20"	014°-26'-20"	070.48352	254+29.968	1144.4111	1144.4721	1.6250000
4	014°-26'-20"	014°-26'-20"	070.48352	254+27.918	1144.5065	1144.6678	1.6250000
5	014°-26'-20"	014°-26'-20"	070.48352	254+25.873	1144.5011	1144.8638	1.6250000

Printout 4

USE:

TYPE: COMPOSITE 36 WF 170 TOTAL WT. per ft. = 218 lbs. D. L. REACTION (K) = 042.86

COVER PLATES: TOP = none BOTTOM = 14 x 1.000 x 46.66 ft.

UNIT STRESSES (KSI): Fbs = 17.89 Fts = 15.59 Fcc = 0.595

MAX. SECTION	I	Sbs	Sts	Scc
STEEL ONLY	014245.48	0948.7909	0643.2635	
COMP. (n=10)	034637.27	1268.9431	3511.5376	2053.9363
COMP. (n=30)	024193.25	1150.5045	1499.7411	1045.8953

Shear Conn. (Spacing, Inches / Length, Feet)

4.500 / 5.000 5.000 / 8.000 7.000 / 9.000 9.000 / 7.000 12.000 / 6.500

Printout 5

Group V Dead Load + Wind Load + Temperature + Shrinkage

```
.00001100'
0+290500'3'-0000000'1+040304'35'40'35'0'-0000000'0+070310'17'18'17'-0000000'
0+070315'24'26'28'25'-0000000'0+140320'0'0'0'0'-0000000'2+070324'144'-0000000'
2+070330'210'210'210'-0000000'0+290340'1'2'3'4'0'-0000000'1+100400'624'862'-0000000'
1+100410'862'862'862'-0000000'1+100420'862'624'-0000000'1+070500'5'90'-0000000'
1+070510'5'90'175'-0000000'1+070520'80'165'-0000000'0+290460'2'3'2'-0000000'
1+100334'366'-0000000'5-100335'-0000000'-0000000''
```

Part 1 Table of Joint Moments (ft.-kips) and Column Base Reactions (kips)

Column No.	Joint Moments Joint A	Joint B	Joint C	Joint D	Col. Base Reactions Vert.	Horiz.
1	0000	-0294	0294	0572	107.0	-027.7
2	-0497	0283	0214	0210	293.7	-016.3
3	-0350	0351	-0001	0008	282.4	-000.3
4	0072	0000	-0072	-0121	130.1	007.7
				Total		-036.6

Part 2 Table of Beam Moments (ft.-kips) and Beam Shears (kips)

Tenth Point	Span No. 1 Moment	Shear	Span No. 2 Moment	Shear	Span No. 3 Moment	Shear
0	0294	072.5	-0283	144.5	-0351	090.2
1	0339	006.5	-0139	054.5	-0200	066.6
2	0347	002.9	-0044	050.7	-0056	083.1
3	0349	-000.6	0044	046.9	0082	079.5
4	0349	-004.2	0125	043.2	0214	075.9
5	0335	-007.8	0199	039.4	0297	-013.9
6	0215	-097.5	0112	-050.6	0270	-017.4
7	0046	-101.1	0017	-054.4	0238	-021.0
8	-0129	-104.7	-0084	-058.2	0199	-024.6
9	-0310	-108.2	-0192	-061.9	0154	-028.1
10	-0477	-111.8	-0350	-151.9	0072	-088.1

goes automatically from one to the other.

Part 1. With known length and width of the rectangular footing, and known angle of eccentricity with respect to the normal axes, the program computes and prints all combinations of maximum allowable bending moment and axial load, and bearing pressures of footing corners at various ratios of eccentricity to total footing length projected in the direction of eccentricity. The computations take into consideration the maximum allowable bearing pressure under the footing and the inability of the footing to develop any bond with the supporting soil. Moment-load charts for differennt angles of eccentricity (for example, 0, 15, 30 and 45 deg) and for different sizes of square footings (5 ft 0 in. to 15 ft 0 in. at 6-in. intervals) have been plotted. Thus, given the maximum allowable bearing pressure and the combined bending moment and axial load, the size of the required spread footing can be obtained directly from the charts.

Part 2. With known length and width of the rectangular footing, the program computes the required depth of footing and the area and perimeter of reinforcement for different uniform bearing pressures. A depth and reinforcement selection chart for square and rectangular footings (from 5 ft 0 in. to 15 ft 0 in. at 6-in. intervals) has been plotted for direct design use.

If the pier bent is on piles, one more program is called into use. A tentative arrangement is placed in the computer and an investigation of the maximum load on each pile is analyzed and returned by the computer. The speed at which this phase of the work can be done is illustrated by the use of the program for the final pile layout of two abutments and three piers (of our typical bridge), which can be carried out in less than twenty minutes.

Component D. Abutments

The abutments of standard interstate highway bridges are generallly divided into two groups: stub abutments and full-height abutments. Stub abutments generally range in height from 8 to 12 ft and are usually designed by the individual states and presented to the consultant as a standard design. In this instance the work to be done involves a multitude of detail dimensions. With known skew angle, known stringer spacing and deck widths, highway profile data, and standard location dimensions, the program computes and prints out every detail dimension and elevation required for the draftsman. A key diagram showing the location of each computer dimension is used by the draftsman and filled in from the computer printout.

If the abutments are of full height, the detail geometry is handled exactly the same as for a stub abutment. But the structural design of the abutment, whether it be on spread footings or piles, is treated as a separate, individual problem and a modified retaining-wall program is used. Such a problem will be treated in Part III of this series.

Integrated bridge program

As can be seen from the above detailed outline of completed component programs, every design feature of our sample bridge has been programmed and is an every-day operation in our office. The final stage of program development, in which the component programs are blended into one integrated program, is now in progress.

The step from component programming to integrated programming is fairly simple in concept but difficult in practice because of limited machine memory capacities. To go from Component A to Component B, etc., it is necessary to use a linkage program that translates the answers from Component A in the form required for data input for Component B, etc. One example of a linkage program would be the translation of stringer loadings from Component B into stringer reactions applied to the pier for maximum pier stresses. The dead-load reactions are already in the computer as part of the Component B computations. The computer can be instructed to arrive at the correct live-load reactions since the design path for translating wheel or lane loads to stringer reactions is already a part of the program for Component B. The testing procedure for determining maximum effects is then added to complete this linkage program.

The writing of linkage programs is not the main barrier to completing an integrated bridge program. The basic problem is to find space for the storage of the linkage programs in the memory section of the computer, plus storage capacity for all the other programs required. At present, computers with sufficient memory capacity to handle a completely integrated bridge program are generally not economically feasible for the average consulting firm to operate and maintain. However, as computers become part of our engineering life, computing centers will be organized where machines of sufficient capacity will be available to individual consultants. The integrated bridge program will then become as routine as the component programs have become today.

An examination of the design time necessary for the present component programming shows that most of the time is spent in the manual preparation of input data. These input data are to a great extent repetitious in nature but they are modified slightly each time they are entered into a different component. For example, the basic alignment data for the general bridge geometry of Component A, and the abutment geometry of Component D, are almost identical. Yet they must be written twice under the present mode of operation. The input data for each pier are practically the same and their manual preparation can be practically eliminated by all-inclusive linkage programs that will take only minutes to prepare, instead of the hours now required for manual preparation.

It is therefore safe to assume that the preparation time for data input can be reduced to approximately 2½ hours if a computer with sufficient memory capacity is employed. Since the larger computers operate at speeds thousands of times faster than our present small-capacity machines, 1½ hours for machine time is a very conservative estimate. The prospect of a bridge design in 4 man-machine hours is therefore very good.

Conclusions

While this discussion has dealt exclusively with one type of highway bridge structure, component programs have already been completed by the authors' firm and are in use for other types of bridges—for continuous welded girder bridges, cantilever girder bridges, and any combination of these. Several linkage programs leading towards total integration are in final stages of development.

Programming for flat-plate buildings, including column loadings; circular concrete tanks; prestressed concrete; arch bridges; etc., are all rapidly becoming part of the library of completed programs. It must be recognized that each addition to this library means that another difficult problem is being handled by electronic computer rather than by human agencies.

The time has come for engineering schools to make their students aware of the capability of computers and to give them facility in the use of these machines. The practicing engineer also must consider this new tool and absorb it into his professional life. Otherwise he may find himself a severely handicapped competitor of a machine that can "design" a bridge every four hours.

Six-lane tied-arch bridge across the Ohio

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Because it incorporates recent developments in design techniques, materials and construction procedures, a new bridge across the Ohio River is of particular interest. This six-lane double-deck structure consists of twin tied arches in two spans of 800 ft each. It is on east-west Interstate Route 64 between Louisville, Ky., and New Albany, Ind. With an overall construction period of thirty months required, the bridge is scheduled for completion about the end of this year. The construction costs, including immediate approaches, will exceed $14,000,000. The bridge is ultimately expected to carry 50,000 vehicles daily.

The need for additional facilities for crossing the Ohio has become extremely acute in recent years. Studies for new crossings have been made from time to time but financing problems have always prevented an effective solution. The advent of the National System of Interstate and Defense Highways resolved the problem of financing but it was still necessary to correlate and update all previous studies before the Interstate Routes in the area could be intelligently planned, and of course, before the needed crossings could be laid out. Together with a companion bridge now under construction over the Ohio on north-south Interstate Route 65 between Louisville, Ky., and Jeffersonville, Ind., the project here described represents the answer that was found to the problem.

In Fig. 1 are shown the routes finally selected, based on a reconnaissance study made in 1958 for the Indiana State Highway Department and the Kentucky Department of Highways by Edwards and Kelcey. The report recommended that two six-lane bridges be built to accommodate traffic anticipated in 1978, one on east-west route IR-64 and one on north-south route IR-65.

Two main spans for navigation

For the New Albany bridge, the requirements of navigation dictated two main spans, each providing a horizontal clearance of 780 ft and a vertical clearance from 92 to 100 ft above the normal pool. The permit issued by the Department of the Army for the crossing so specified. Navigation interests further fixed the location of the main piers with respect to the stream bed. This, coupled with alignment problems on the Louisville side to minimize damage to Shawnee Park and to accommodate the alignment of IR-64 to the east, using portions of the existing levee, plus right-of-way problems on the New Albany side, pinpointed the bridge location and dictated two main spans of about 800 ft each with little or no opportunity for structural continuity with the immediate approaches. See Fig. 2.

Foundation conditions are uniform and presented no problem. The area is underlain at a relatively shallow depth by New Albany shale, which has ample supporting capacity for any structure. The river at this point is relatively shallow at normal pool.

Numerous plans were studied for the two main spans and comparative estimates prepared. Simple tied-arch trusses with suspended decks were finally selected. This choice was influenced to a considerable extent by a desire for the esthetically pleasing structure the location demanded.

With the selection of a tied arch as the basic design concept came many problems and questions, one of the first being double versus single deck

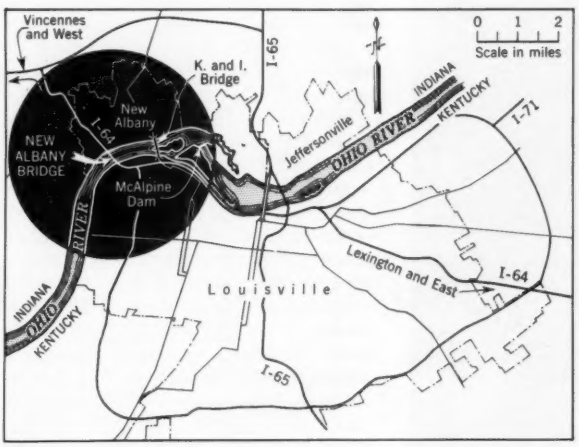


FIG. 1. Routes in the Louisville, Ky., area

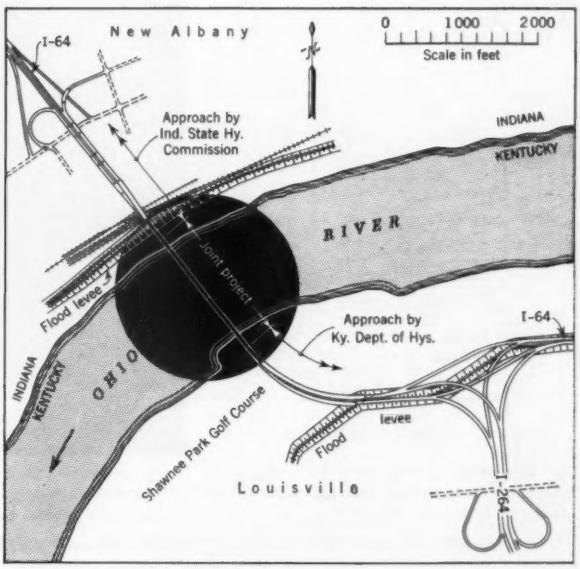
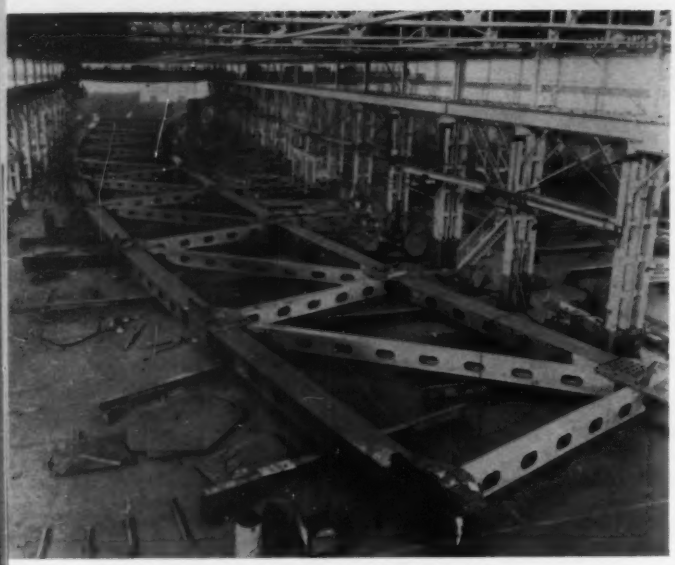


FIG. 2. Site plan of New Albany-Louisville Bridge



Trial assembly of a bridge truss at R. C. Mahon Company fabricating plant in Detroit.

TABLE I. Allowable unit stresses in steel, kips per sq in.

Type of Steel	Thickness, in.	Yield Strength	Tension DL	Tension LL	Shear	Bearing (milled ends)
A7 and A373	Varies	32	20	18	11	27
A242	to ¾ incl.	50	30	27	15	40
	Over ¾ to 1½	46	26.7	24	14	36
	Over 1½ to 4	42	24.4	22	12	32
Heat-treated, high strength	to 2½ incl.	100	45	40	23	60
	Over 2½ to 6	90	40	36	21	54

Note: For allowable compression, see Fig. 3.

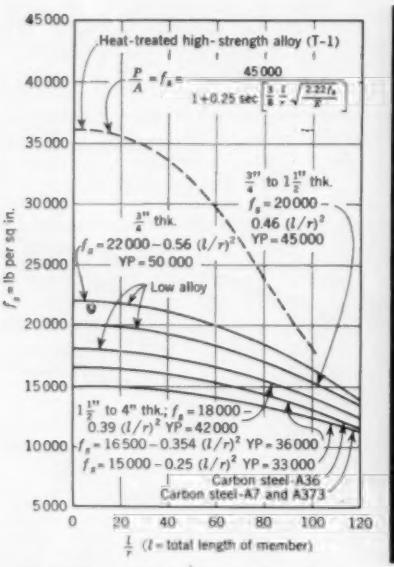
TABLE II. Required weld-metal properties of steel, kips per sq in.

Type of Steel	Tensile Strength	Yield Strength, Min.	Elongation in 2 in., Min.	Reduction in Area, Min.
A373	62-80	45	25%	40%
A242	70-80	55	25%	40%
Heat-treated, high-strength:				
Fillet welds*	80-100	70	25%	50%
Fillet and butt welds†	115 min.	100	18%	50%

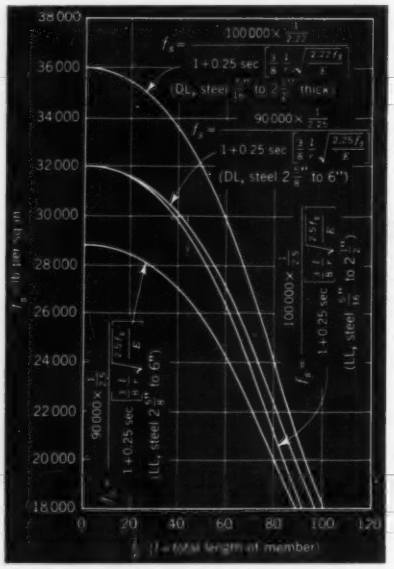
* Connecting components of members.
† Primary strength.

FIG. 3. Location of different steels in the bridge.

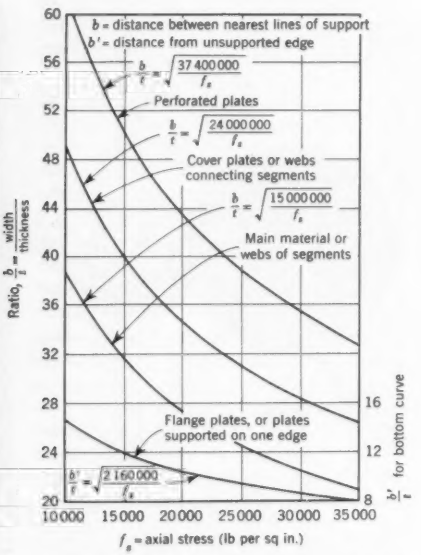
construction. This was resolved for this particular site by an economic comparison between the two, giving the necessary consideration to the cost of the approaches. Generally speaking, a major truss bridge designed for six lanes of traffic is less expensive as a double-deck structure but sometimes this creates problems in economics, grades and other features on the approaches, which can equalize or outweigh the advantages of the double


Heat-treated high-strength alloy (T-1)
Low alloy
Carbon steel-A36
Carbon steel-A7 and A373
f_s = lb per sq in.
$\frac{l}{r}$ (l = total length of member)

(a) Allowable working stress for compression members concentrically loaded, with riveted ends.



(b) Allowable working stress for columns of heat-treated, high-strength alloy-steel (T-1), concentrically loaded, with riveted ends.


b = distance between nearest lines of support
b' = distance from unsupported edge
Perforated plates
Cover plates or webs connecting segments
Main material or webs of segments
Flange plates, or plates supported on one edge
Ratio, $\frac{b}{t}$ = width / thickness
f_s = axial stress (lb per sq in.)

(c) Allowable plate thickness, that is, method of determining width-to-thickness ratios for component plates in compression members.

FIG. 4. Condensed engineering data for the tied arch.

deck in the main spans.

For this project, the curving south approaches lent themselves conveniently to a transition from the double-deck trusses to a common grade at about the Louisville levee; the north approaches presented no particular problem. Hence in this case the basic economy of the double-deck design was not lost in the approaches and the net advantage was estimated at $300,000. Grade problems on the approaches dictated that northbound traffic be assigned to the upper deck and southbound traffic to the lower.

Tie of high-strength steel

When the tied-arch design was first envisioned, it was of course expected that some kind of high-strength steel would be used in the tie. With the concurrence of the two states and the U.S. Bureau of Public Roads—influenced to a considerable extent by the successful use of T1 steel by the State of California in the Carquinez Bridge and elsewhere—it was decided to use a high-strength, low-alloy, heat-treated steel for the tie. It was also used in the arch trusses in locations where it proved economical. See Fig. 3. Similarly, A242 steel was proposed for floorbeam frames and truss members where it would be most economical. The remaining members were to be of A7 or A373 steel. (See ASTM specifications for A242, A7 and A373 steels.) As all these materials are weldable, added economies could be gained from welded fabrication and the use of high-strength bolts for field connections. Gusset and splice plates were shop-bolted to the main material for the two arch trusses. No field welding involving stress-carrying members was employed.

The allowable unit stresses for the several steels used are shown in Table I. It should be noted that the maximum values (up to 45,000 psi) for the high-strength, low-alloy, heat-treated steels are about 45 percent of the yield strength; also, that the allowable values for live load and impact are reduced by another 10 percent. It follows that the use of these new materials has been on a somewhat conservative basis. Requirements for weld strengths and ductility are given in Table II. Specifications did not prescribe the rod and flux to be used; rather the fabricator developed them as required to meet the specifications and proved their acceptability for the several materials and types of welds as a part of the extensive testing program carried out before fabrication began.

The formulas for compressive stress given in the AASHO design specifications for plain carbon steel and for A242 steel were plotted as shown in Fig. 4 to allow a quick determination of permissible unit stress for a given slenderness (l/r) ratio. For the heat-treated, high-strength steel it was necessary to select an acceptable formula for permissible compressive stress, and the well-known secant formula was used with modifications for inherent crookedness or eccentricity and for riveted end restraint. The curves as plotted were for the two yield-point groups and the two load-condition groups shown in Tables I and II. The third set of curves are those for determining the width-to-thickness ratios for the component plates making up the members. The formulas from which these curves were plotted are based on the theoretical equation for critical buckling in plates. The equation was modified by using accepted edge-restraint constants and a reasonable safety factor.

Each member was designed of the most likely materials and the material that proved to be the most economical was selected. Unit prices of 40, 30 and 28 cents per pound respectively were used in this analysis for the heat-treated, high-strength steel, for A242 steel, and for ordinary carbon steel. Tension truss members were designed for net section with their ends increased in thickness by butt welding to maintain the required net section through the bolted connections. As shown in Fig. 3, the high-strength material predominates; in fact, 71 percent of the truss, including the tie, is made up of this material. Gusset plates are of the same material as the member with the higher unit strength which enters the joint. Steel of firebox quality was not required for the gussets.

While it is impossible to state exactly the amount of money saved by using the several grades of steel with welded fabrication, as compared to the materials and practices common a very few years ago, the estimated saving for the main spans exceeded 10 percent. The two arch spans contain 14,075,881 lb of structural steel. Of this total, about 1,500 tons is T1 from the U. S. Steel Corporation and 1,000 tons is N-A-Xtra 100 steel manufactured by the Great Lakes Steel Corporation. Both these metals met the specifications established for heat-treated, high-strength steel.

The rigid frame supporting the two 42-ft roadways is shown in Fig. 5. This is suspended from the arch trusses by four 2½-in. round bridge strands, two on each side. The frame, of A242 steel, proved to be of particular interest during the design and construction phases. The design load for each pair of suspenders is 500 kips and the specifications required that the strands be cut and socketed top and bottom. Two of the completed assemblies were tested to three times the design load (or 750 tons). Shims were provided for adjustment in length where necessary between the two strands, which are paired.

Stringers run continuously over the top of both top and bottom members of the frame and help provide rigidity for the suspended decks. Stringers for the top level are continuous for half the 800-ft span while those for the bottom level are continuous over three or four panels. There is a bottom lat-

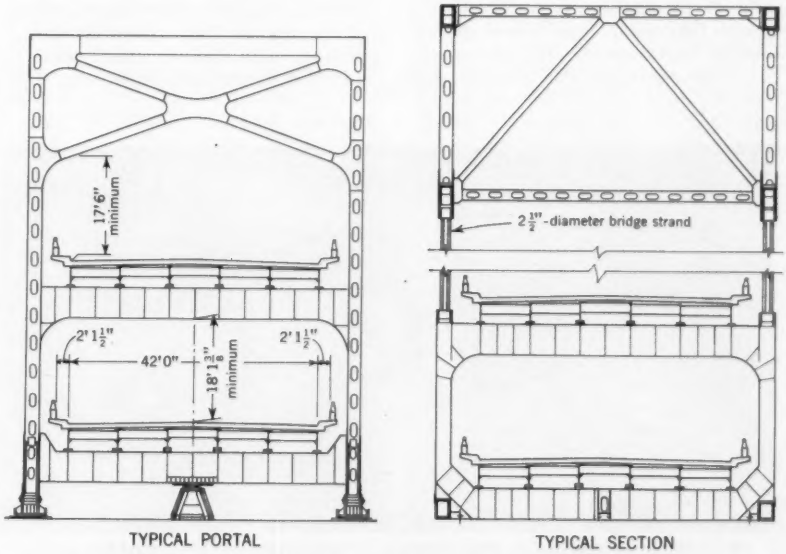


FIG. 5. Typical portal, left, and section through main span of bridge.

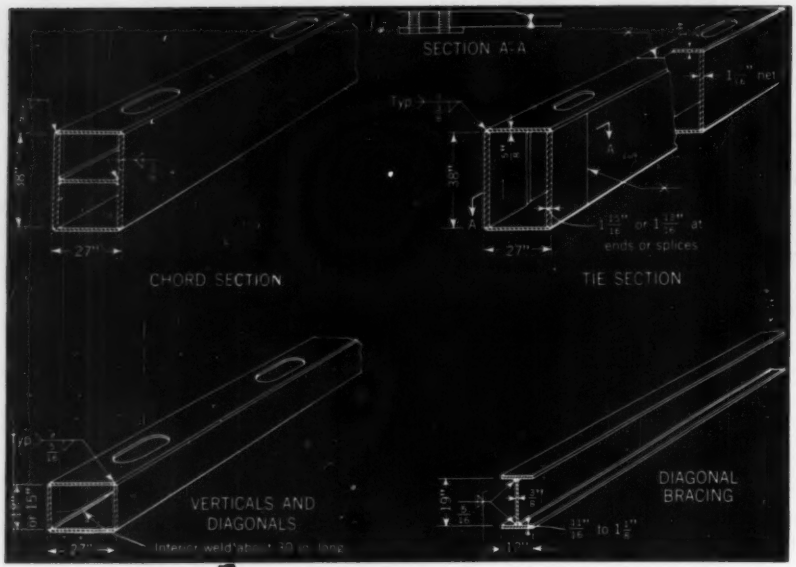


FIG. 6. Structural details in major members of the tied arch.

eral system of bracing in the plane of the tie. The tie itself is attached to the bottom corners of the frame for support only. The problems of the erector in this type of design must always be borne in mind by the designer. This arrangement of the frames and stringers fitted into the expected erection scheme.

Of interest is the anchorage appearing under the center of the end floorbeam in Fig. 5. Lateral forces acting on a simple span of this length would create a sizable end moment if fixed shoes were placed in the conventional manner at one end of the span. Here the rather close spacing (51 ft 6 in.) of the trusses would reduce the lever arm of the resisting couple with the result that each shoe would be required to transmit an abnormally large force into the pier. This force, in addition to the regular vertical loads, unduly complicates the shoe design—in fact, for this project it made the design impracticable.

Such lateral forces also create problems in pier design except for very tall and relatively flexible shafts. The problem was solved here by the simple expedient of elimination—and by placing rocker-type shoes under all four corners of each of the tied-arch spans. Stability is provided by the aforementioned anchorage, which permits longitudinal movement at one end of each truss—the free end—and rotation only at the other—the fixed end. All lateral loads are eventually transmitted to a 4-in. pintle plate which is fastened to the end floorbeam at the center. The bottom element, a casting, with a 10-in. round pintle, is attached to the anchorage using eight high-strength bolts (ASTM A354) 3 in. in diameter, the holes for which were drilled in the field for final adjustment.

The various types of members used in the makeup of the truss and tie are shown in Fig. 6. Fabrication was entirely by welding with fillet welds up to ½ in. Butt welds up to 2¼ in. in thickness were required to obtain the necessary length of material for the various truss members and to increase the thickness of members as they entered into joints and connections. All fillet welds were inspected by the magnetic-particle method while all butt welds were completely radiographed.

Before welding started, the fabricator, the R. C. Mahon Company, prepared welding procedure specifications geared to the firm's equipment and personnel. Methods were proved by tests in accordance with the AWS Specifications, as modified for this project. It was also required that welding operators on other than plain carbon structural steel be specially qualified for work on the particular metals to be used. Tandem-arc automatic welders were used on much of the work.

Erection of tied arches

The erection peculiarities inherent in the tied arch are well known. Many sites do not lend themselves to this type of construction since the basic economies often disappear quickly in the added materials and special procedures required for erection. At this site there was no restriction on the use of falsework for the south span. Under the north span, however, a 500-ft navigable channel had to be maintained at all times, this channel being adjacent to the middle pier. It was therefore anticipated that the south span could be erected first and then used to assist in the erection of the north span.

It was assumed that the erector would handle the steel from topside using a conventional traveler on the top chord. This would have required that several members be increased in size. The John F. Beasley Construction Company, erection subcontractor, simplified erection problems immeasurably by erecting everything from below, thus eliminating the traveler working on the top chord. As a result, only four members in each truss were modified for erection purposes, other than the extension of a few gusset plates to facilitate tiebacks.

The extra amount of steel that will remain in the bridge as a result of this method of erection is 16,600 lb, or about one tenth of one percent. The erector used a somewhat oversize rig

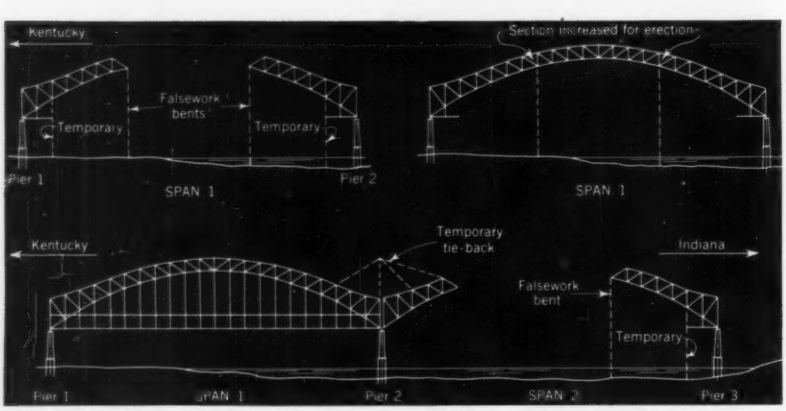
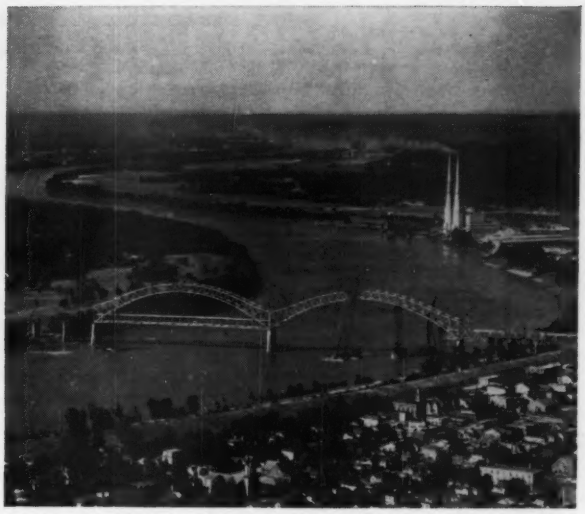


FIG. 7. Major erection phases show simplicity of falsework used. Extra steel for erection was almost eliminated by use of a large floating crane to erect the two tied-arch spans.

Erection of south span was started during high water. Note counterweight blocks, which are in place at portal, and completed steelwork for the north approach trusses.



Erection of main spans nears completion. Note tieback to completed arch at the center and the two bents of falsework at right. Both photos, courtesy *Courier-Journal* and *Louisville Times*.

to accomplish the work—a floating derrick with a capacity of 400 tons. It had a 250-ft boom and a 75-ft jib. The arches rise to 270 ft above the surface of the water at normal pool.

As anticipated, the south span was erected first using four falsework bents and cantilevering the arch over the center section. See Fig. 7. With this span in place, two false bents were placed in the river for the north span, the southernmost being about 300 ft from Pier 3 so as to maintain the channel width of 500 ft adjacent to Pier 2. The north span was then erected using these bents on the north side and a tieback to the south span on the south side as the arch moved outward from Pier 2. Virtually the only difference between the erector's scheme and that visualized in the design was the use of the very large erection rig and the elimination of the traveler.

Erection of structural steel was substantially completed by the end of July 1961, and the placing of the concrete decks on the arch spans began in August. All work necessary to permit the bridge to be opened to traffic, including curbs and barrier-type railing, the mercury vapor lights for the top deck and the fluorescent lights for the lower deck and the signing and route markers, is scheduled to be completed early in December. The opening is scheduled for December. While both upper and lower decks will be finished at that time, work on the approaches may limit traffic to the lower deck initially.

An IBM 650 computer was used extensively in the several phases of this project. The tied arch is statically indeterminate; it was very advantageous to be able to reanalyze the entire truss with a minimum of effort for each change made during the design phase. A modification of the Houston Truss Program was used for determining the primary stresses. The computer was also used in determining secondary stresses and deflections, the latter requiring the development of special programs for this particular job.

Subsequently the erector was provided with the basic data and he then prepared his erection schemes and determined stresses and joint displacements for the various erection phases using the computer. This project is an example of the very effective use of the electronic computer with a commensurate saving in designer time and increased accuracy in results.

The substructure contract, amounting to $995,000 for the three main-river piers and the three north approach piers, was awarded in June 1959 and completed some 15 months later. The superstructure contract, amounting to $5,400,000 for the two 800-ft arch spans and a 450-ft continuous truss unit on the north side of the river, was awarded in February 1960. An approach contract to the north, including the Market Street Interchange, has been awarded by the Indiana State Highway Commission. South approach contracts extending south to the Louisville levee and east to the 37th Street Interchange have been awarded by the Kentucky Department of Highways. Construction under these several contracts is well under way with completion scheduled so as to provide a facility for local use with connections into the Louisville and New Albany city street systems before the end of the current year. The aggregate cost from interchange to interchange is about $14,000,000.

This project is a joint venture of the Indiana State Highway Commission and the Kentucky Department of Highways in cooperation with the U. S. Bureau of Public Roads. The Indiana State Highway Commission assumed responsibility for coordination and general supervision of the project. For the Commission, George M. Foster, F. ASCE, is Executive Director; J. R. Cooper, F. ASCE, Assistant Chief Engineer; J. V. Smythe, F. ASCE, Bridge Engineer; and Ross A. Robinson, Project Engineer. For the Kentucky Department of Highways, Henry Ward is Commissioner of Highways; D. H. Bray, F. ASCE, State Highway Engineer; and E. D. Smith, F. ASCE, Director of Bridges.

The bridge was designed and field supervision provided by Hazelet & Erdal under the general supervision of the writers with Frank B. Wylie, Jr., M. ASCE, as Principal Design Engineer and Stanley J. Sylwestrak, M. ASCE, as Resident Engineer. Roy Ryan Sons Company, Inc., of Evansville, Ind., is contractor for the substructure and The R. C. Mahon Company of Detroit for the superstructure. John F. Beasley Construction Company of Dallas, Tex., is subcontractor for steel erection; Penker Construction Company of Cincinnati is subcontractor for the concrete decks.

ASCE Holds Annual Convention in New York

The ASCE gavel, symbol of office, passes from Glenn Holcomb, retiring President, to newly installed President G. Brooks Earnest.

A. J. Tobin, left, executive director of the Port of New York Authority, gave a luncheon session an excellent insight into moving masses of people. He is shown with Roger Gilman, Director of ASCE, who was recently loaned by the Port Authority to the new Tri-State (New York, New Jersey, and Connecticut) Transportation Committee.

Finley B. Laverty, right, received the ASCE Professional Award. With him are Craig Hazelet, left, and ASCE President G. Brooks Earnest, whom Mr. Laverty credits for work with him for younger members, which culminated in the Award.

New York was host in mid-October to another successful ASCE Convention, which was attended by more than 2,300. During the five-day meeting G. Brooks Earnest, president of Fenn College, Cleveland, took over from Prof. Glenn W. Holcomb, of Oregon State College, as president of the Society. Gardner Reynolds was chairman of the well-planned program that was geared to the theme of the metropolis of the future.

The Board of Direction, meeting concurrently, approved the plan proposed by Executive Secretary Wisely for a change in the type of meetings to be held by the Society and took other actions, as outlined on page 72. Awards and prizes were conferred at the annual business meeting on Wednesday, October 18.

In addition to the traditional awards for Transactions and CIVIL ENGINEERING papers (see the October issue for biographies of recipients), the ceremony featured presentation of the ASCE Professional Award to Finley Laverty, assistant chief engineer of the Los Angeles County Flood Control District. Mr. Laverty, a former ASCE Director, was cited, "For an established reputation for professional service as a dedicated member of the Society; for his effective work in the advancement of engineering education and the development of future engineers; for significant contributions toward improvement of employment conditions among civil engineers as exemplified by his pioneer effort in establishing job classifications and salary schedules."

At the luncheon following, Samuel B. Morris, George S. Richardson, Thorndike Saville, and Abel Wolman were elevated to Honorary Membership. Mr. Morris was cited "in appreciation of a lifetime of distinguished engineering work, of tireless effort in behalf of the Society, and of outstanding public service in developing the water resources of the West and in advancing fundamental knowledge in the field." Mr. Richardson was honored as "famed consultant and civic leader, in recognition of long and dedicated service in the field of highway and bridge design and in the interests of the profession." Dr. Saville was hailed as "dedicated teacher and world-renowned authority in water resources and costal engineering, who has enhanced the prestige of the civil engineering profession by a long career of accomplishment at home and abroad." Dr. Wolman was honored as "eminent civil engineer, wise teacher, devoted public servant, who has contributed immeasurably to the welfare of man through the advancement of sanitary engineering knowledge and practice."

The attraction of grouped papers by top people, as planned for the new look in ASCE Conventions, was proved by excellent attendance at Power and Structural Division sessions on the last days of the Convention. Even late Friday afternoon sessions were packed.

Weather during the week was ideal for planned tours: Around Manhattan by boat, courtesy of the Port of New York Authority; to the site of the 1964-1965 Worlds Fair in Flushing Meadow and to major bridge and parkway construction projects as guests of the Fair Corporation; and to the Indian Point Atomic Power Plant of Consolidated Edison, now nearing completion. Several hundred took advantage of the time in New York to visit the United Engineering Center and ASCE headquarters on its top floors.

Luncheon meetings

Four luncheon meetings held during Convention week were addressed by nationally known men, speaking on subjects tied into the Convention theme of the metropolis of the future —urban planning, water resources, mass transit, and highways. Announcement was made during the luncheons of the appointment of two ASCE members to important federal positions.

Robert C. Weaver, Administrator of

the Housing and Home Finance Agency, addressed the Monday luncheon on the subject, "Urban Frontier." The expanding activity of the Agency, and the plans of the Kennedy Administration for important changes in it, were shown by Mr. Weaver's announcement that Prof. John Clayton Kohl, of the University of Michigan, will head a new office of transportation within this organization. Just prior to its recent adjournment Congress appropriated $42.5 million to initiate a mass transportation demonstration program in administering planning assistance related to urgan transportation.

For the past nine years Professor Kohl has been director of the Transportation Institute at the University of Michigan, where he has been located since 1946. He has long been active in ASCE affairs and is now chairman of the Executive Committee of the City Planning Division.

Administrator Weaver noted that when the Housing and Home Finance Agency was established it had no urban responsibilities other than housing. Today it is deeply involved with urban development, through planning and renewal, community facilities' programs, mass transportation, and open-space programs. In the fiscal year ending in June more than 90,000 families were displaced by urban renewal, highway construction and code enforcement; the figure does not take account of family displacement caused by private construction and other actions. Mr. Weaver noted that this is the reason the Congress is urged to reconstitute these programs into a Department of Urban Affairs and Housing.

Urban highways

Speaking on "Metropolis 1980—Urban Highways," Federal Highway Administrator Rex M. Whitton pointed out that there is much to consider in planning for urban highways that will be a beneficial part of our cities in 1980 and for many years to follow. Planners, engineers, and administrators will have to come to grips with the facts that exist in the area and collectively recognize that the city as it exists today is a success. Perhaps it is not the Utopia that might have been, but it provides for the needs, satisfactions, and economic well-being of its citizens. There should be assurance of retention of those area developments already in existence that are of great benefit to its citizens as well as of the creation of new beneficial developments of the type and scale that the citizens want and are willing to pay for. The value of the new Interstate System of highways to urban populations is emphasized by the fact that, while the Interstate comprises little more than 1 percent of all road and street mileage, it will carry more than one-fifth of all traffic. Since there are more than 400 urban communities with a population of 25,000 or more that will have one or more Interstate routes, the effect of the highway program is truly nationwide.

New Honorary Members get together for a chat during the Convention. They are (in usual order) Thorndike Saville, Samuel B. Morris, Frank S. Richardson, and Abel Wolman.

Administrator Whitton announced at the meeting the appointment of D. Grant Mickle, director of the Traffic Engineering Division of the Automotive Safety Foundation, as Deputy Federal Highway Administrator. This is a newly created position, which replaces the Commissioner of the U.S. Bureau of Public Roads. Mr. Mickle has been in traffic and highway planning work since the early 1930's and with the Automotive Safety Foundation since 1943.

Utilities for 1980

Samuel S. Baxter, water commissioner and chief engineer of the City of Philadelphia and a Director of ASCE, took a conservative view of changes that can be expected by 1980, but predicted that for the long-range future there is no limit to what engineers and scientists can accomplish. Concerning water, he said that the big need is storage, transmission, and treatment of the high order of other utilities. Even if a real breakthrough in water handling should come in five years, there would be little change by 1980, due to inertia and lack of money. He commented that we are doing ourselves a disservice by crying that there is a water shortage in this country, when the fact is that the real shortage is in water works, or facilities to store, transport, treat, and distribute water.

We need research on desalinization

Past President J. C. Stevens (left) congratulates winners of the prize bearing his name—Everett V. Richardson and D. B. Simons—during Wednesday morning program. Retiring President Holcomb, who made the presentations, is at the right.

William A. Bugge, left, of Washington, until recently president of AASHO, with D. Grant Mickle who was just made Deputy Federal Highway Administrator; Rex Whitton, Highway Administrator; and John C. Kohl, named Administrator of an Office of Transportation in the Housing and Home Finance Agency.

of sea water but we need to realize that the tremendous sources of fresh water will meet our needs economically for many years beyond 1980—with proper care and facilities, he said. Mr. Baxter predicted that electric consumption would double by 1975 and again by the year 2000. Only a small amount of this will be nuclear. He hazarded the guess that we might communicate without telephones by 1980 and speculated on the possibility of a small individual fuel cell for each home to take care of home utilities in the future.

Balanced transportation

With the theme, "Balanced Metropolitan Transportation for the Future," Austin J. Tobin, executive director of the Port of New York Authority, told another luncheon group that even in America we cannot afford the luxury of bulldozing down what we have and starting all over again. We are confronted with a vast complex of different problems in different areas that will require different solutions, built into and upon, and threaded through our existing transportation systems.

Railroad commuter transportation is particularly equipped to handle great numbers of passengers between the large and more densely populated suburban areas in the central core. In sparsely populated areas and areas where the travel requirements are not to and from a central urban core the automobile is the most effective means of transportation. In the middle ground, between areas of medium population density and the central core and between some peripheral areas, the bus provides the necessary flexibility and economy for effective mass transportation service. In the New York area, bus transportation will become increasingly important in serving metropolitan areas because it can serve the growing suburban population with both the flexibility of the automobile and the economy of mass transportation.

Mr. Tobin had some hard words for the headline hunters with catchpenny plans for vast new automated, integrated and, in many cases, somewhat aerated transit ideas. He does not feel that we need self-advertised experts with patented transportation nostrums, abstract and Utopian planners of future dream cities, or the noisy publicity of those who simply wail at the walls of the Megalopolis. Sound transportation planning and metropolitan planning need the talent and training of professional engineers as well as practical and experienced professionals in the field of planning, finance, law, and administration.

Special women's program

So many events were planned for the visiting ladies that they rated a program of their own. Mrs. Gardner Reynolds headed the committee of local wives, who had arranged the program that included a wide variety of entertainment and sightseeing.

Perhaps the most stimulating and unusual event on the ladies' calendar was the Thursday morning Continental Breakfast, followed by a program devoted to the new look in cities. James W. Follin, former Urban Renewal Administrator and now a consulting engineer in Washington, described the nation's $4 billion long-range program for "modernizing the Nation's plant to meet the needs of our growing population." With the nation's future now centered in its cities, the urban renewal program is of the utmost importance. Mr. Follin's talk was accompanied by colored slides and a film, showing what can be done, what has been done, and what must be done to avert large-scale depreciation and obsolescence of our metropolitan centers.

Attesting to the interest in the program were the searching questions asked Mr. Follin at the conclusion of his talk. Some of the ladies who heard him are members of their home city planning commissions.

Condition of Practice sessions

Professional and educational aspects of the practice of engineering also received the attention of those attending the Annual Convention. In addition to the inclusion of these phases at some of the technical sessions, four of the eight committees of the Department of Conditions of Practice sponsored sessions entirely devoted to professional matters. These were the Committee on Younger Members, Committee on Engineers in Public Practice, Committee on Engineering Education, and the Committee on Professional Practice.

New York's Deputy Mayor Paul R. Screvane urged those attending one of the sessions to encourage young engineers to develop administrative abilities. For a completely successful career in public service an engineer must have executive ability.

Outlining what must be done to recruit top engineers, Raymond Jacobsen, chief of the Standards Division of the U.S. Civil Service Commission, urged his compatriots to outbid industry in terms of challenge, opportunity for professional maturity, and other attractions such as research facilities that are often available in government agencies. He urged greater flexibility in recruitment techniques. He recommended that colleges be relied on to indicate their top men as evidenced by their campus records—both academic and extracurricular.

Research and graduate training were stressed at the education session. Prof. R. E. Stiemke, director of the School of Civil Engineering at Georgia Tech, told a capacity audience that a top-notch undergraduate civil engineering program is dependent on a good graduate program. Likewise, young men interested in pursuing graduate work will want to do research. Graduate programs and research must be developed simultaneously. Professor Stiemke emphasized that the schools must put money into

embryo research programs before they can be developed and "sold" to industry or a foundation.

Technical Division programs

Technical sessions, the real meat of the Convention, were dominant on all five days. Some Divisions provided quite comprehensive symposia to take engineers up to the 1980 date on activities in their field.

The Air Transport Division led off in this area with plenty to say about problems now and in the future. Transportation on the ground was given a large part of the time on the program, somewhat commensurate with the time entailed in travel to and from the airport. This was brought out particularly in a joint session with the City Planning and Highway Divisions.

Ground transportation time, said E. E. Ditmars, director-schedule analysis, American Airlines, has shown substantial increases, while air time has been cut in half. A Washington-Los Angeles trip in 1951 required 90 minutes of ground transport time compared to 140 minutes now. Air time was 10 hours in 1951, and is 5 now. Percentage-wise, ground time is much more important on short trips. Mr. Ditmars pointed out that Greyhound now has passenger express service from Milwaukee to O'Hara field in Chicago that allows a passenger to leave downtown Milwaukee 40 minutes later than he would to take the best air connection from Milwaukee to O'Hare.

D. C. Hazen and J. E. Snell, of Princeton University, came up with the initials STOL (short takeoff and landing) for a machine looking for a place to land in 15 years. It would be a propeller-type aircraft built in sizes of from 4- to 50-passenger capacity and would land at stations located on perimeter metropolitan areas, where it could connect with surface mass transit and a highway network. The STOL machines could use a 1,000- or 1,200-ft runway, touching down at speeds of 30 to 50 mph. They might be useful for distances as great as 500 miles. In a predication for the next two decades the author stated that in a typical city of 1 million population about 1,200-000 inter-city trips will be made daily. Of these 44 percent will be to and from work, 7 percent for business transactions, 8 percent for school, 10 percent for shopping, 18 percent for other reasons. The authors predicted that a system using a 300-mph STOL machine can make short-range passenger traffic compensatory.

Very few runway pavements are built for tomorrow's aircraft, Ronald L. Hutchinson and Thurman R. Wathen, of the rigid pavement laboratory, U. S. Army Engineer Ohio River Division Laboratories, Cincinnati, Ohio, stated in a paper before the Air Transport Division. Such new construction continues, despite the fact that the gross weight of aircraft continually grows. Some rebuilding can be done by adding thickness to the present pavement to carry the heavier loads. Another solution is to distribute the heavier load over a greater area. This then becomes the problem of the aircraft designer but since he is not a pavement engineer, he does not often understand the problem or the solution.

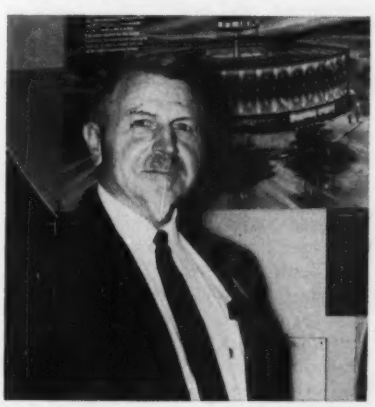
Robert Horonjeff, professor of transportation engineering at the University of California, Berkeley, told more about the pavement problem of the future. Supersonic transport planes will have a weight from one-half more to twice that of the present-day jets and will have takeoff and landing speeds 25 percent higher. The length of the plane is likely to be much greater but wing spans may be less due to a different configuration. Greater thrust from engines and larger spread of loads on more wheels will help to keep required changes in pavement to a minimum. Mr. Horonjeff believes runways should be planned for 1,500 to 2,000-ft greater length and pavement thickness increased from one-third to one-half for planes of the near future. Widths of runways and taxiways probably can remain about as they are, but curves on taxiways will have to be widened to accommodate the different configuration of the new planes.

Air cargo is the fastest-growing segment of the transportation business both as to numbers of shippers and kinds of freight that move by air. But there are pitfalls, problems, and plenty of room for improvement in this business, said Stanley H. Brewer, professor of transportation, University of Seattle. Less than 0.05 of 1 percent of the total intercity ton-miles of freight moves by air. Even optimistic predictions for the next 20 years show that the industry will not be able to capture 1 percent of the total. Air cargo has a place in the future transportation picture, but it will be limited by the present cost of 20 cents a ton-mile average compared to 5 to 11 cents a ton-mile for motor common carriers. Cost of moving freight through air terminals is now 10 to 20 times as high as comparable freight moved through motor carrier facilities, so that cutting the cost of movement in the air is far from the whole answer to the problem of competition. At present air-freight rates are three to

Executive Secretary William H. Wisely is pictured (upper left) with Secretary Emeritus William N. Carey (center) and new Honorary Member George Richardson, of Pittsburgh.

Some 400 students from schools as far away as the University of Puerto Rico joined their fellow engineers at the Convention. Most of them heard Mark Whipple (lower left), Brig. Gen. U.S. Army, Ret., and chief engineer of the New York World's Fair Corp., and Prof. W. T. Ingram, New York University, address the Student Chapter Conference. Both men addressed their comments to the problems to be faced by the students serving as tomorrow's engineers.

Waldo Smith, new Director for District 5, is seen viewing the U.S. Steel Exhibit at the Civil Engineering Show, an Annual Convention highlight.



A combined Waterways and Harbors and Construction Divisions session had (left to right) Evan W. Vaughn and Wm. Kinneman as presiding officers with speakers Capt. W. R. Boyer of Boston, Lt. T. N. Tate of Bremerton, Wash., and C. J. Murphy of New York. The session was on drydocks and harbor development.

four times as high as surface carriers on transcontinental hauls and are justified for only a few items.

City planning

City planners heard about urban renewal, new concepts in zoning and—in a joint session with the Highway Division—about the roads to get people to and from work.

Ground-based wheeled vehicles will dominate the transportation scene through the rest of this century. This is the opinion of Wilbur S. Smith, trasportation consultant of New Haven, Conn. Thus the access to each parcel of urban land will be by land, over streets and highways as provided today for traffic and other utilities. Estimated urban freeway needs approximate 10,000 route miles for 1960, about 13,600 for 1972, and 14,500 miles for 1975. By 1980, 16,000 miles will be required in urban areas. The entire urban freeway mileage presently in use amounts to almost 3,000 route miles, less than 30 percent of the 10,000 miles that are needed now. Future mass transit (excluding the largest cities) will be provided by express buses operating on freeways, either within specially reserved and designated peak-hour transit lanes or along special median bus lanes.

Dr. Alex L. Hart, director of the New York-New Jersey Transportation Agency, reported that the New York City subways are the principal mode of transportation for more than 55 percent of the journey-to-work riders in the New York metropolitan area. Railroad commuter services are second with 18.2 percent, and bus services are third with 16.6 percent. In 1961 public transport services were the principal means used by 94 percent of the journey-to-work riders. Dr. Hart said, "Increasingly it has been recognized that urban renewal projects would not in themselves accomplish rehabilitation of the core areas if facilities for journey-to-work transportation from and to the core area were allowed to deteriorate and thereby contribute to the economic decline of the central employment function."

Waterways and Harbors Division

A lot can be done to increase the capacity and efficiency of the Panama Canal at relatively low cost. This was the gist of two specially interesting papers presented before a Waterways and Harbors Division session. The Governor of the Canal Zone, Maj. Gen. W. A. Carter, of the Corps of Engineers, and R. D. Brown, Jr., director of engineering and construction for the Panama Canal Company, told about a means devised to reduce down time for a lock for overhaul of gates from two weeks to 24 hours.

Gate leaves weigh up to 790 tons for a differential head of 33 ft in the 110-ft-wide locks. Pintles were designed in 1904 for much higher bearing than would now be considered practical, and there has been difficulty with them over the years. An extra set of gates at each end of each lock makes it practical to remove and repair one set. Key to work on the bearings for the pintle and the wall is a 7-ft-dia half-circle portable cofferdam. After removal of the gate by derrick boat, with assistance from buoyancy of the gate, the small cofferdam is then put in place and pumped out. Small ships can continue to use the lock while larger vessels are assigned to the fully operational companion lock.

S. C. Hollister, dean of engineering at Cornell University, summarized an extensive report prepared for the U. S. Congress by the Board of Consultants on Isthmian Canal studies. This study covered present capacity of the Canal and the needs for the future. The increased efficiency offered by the plan outlined by Governor Carter was recommended for immediate augmentation with widening of areas of the Canal to permit effective two-lane operation. Substantial increase in the capacity of the Canal can be obtained at a cost of $61 million. A third set of locks—longer, wider and deeper than the present channels—can be provided for $733 million. A sea-level canal in the present Canal Zone—cutting across the present Canal at three points—would cost $2.5 billion. It is possible that a sea-level canal across northern Colombia could be constructed by nuclear means at a cost of $1¼ billion. (By contrast the often-discussed Nicaragua lock-canal would cost more than $4 billion.) The Board, which included ASCE Past President Francis S. Friel, recommended that a sea-level project in the Canal Zone should not be undertaken in the near future, but that investigation of opening a canal by nuclear means should be vigorously pushed.

Highway Division

Much concerning the highway engineer and his role in "Metropolis 1980" was presented during the several sessions sponsored by the Highway Division.

The Transportation Policy Group in Washington was represented at the Convention by Albert A. Atwell. Mr. Atwell said that long-distance vehicular transportation in the near future will be by high-speed, high capacity, automatically controlled systems employing individual vehicles. With an automatic highway program, capacity can be increased from four to six times the present rate, accidents will be reduced, point-to-point time will be reduced, and the driver will be enabled to make better use of time en route. Mr. Atwell described a three-phase approach that is currently underway by the federal government. Phase one comprises a through systems analysis and will be followed by a two-year experimental phase. The final phase of the initial approach will be a demonstration period utilizing two of the concepts on an 80- to 100-mile stretch of the interstate. So far the systems currently in the lead for further development are radar, mechanical, and inductive cable.

That automated highway travel presents many problems was agreed upon by all of those speaking on the subject. One such problem is that of economics. K. A. Stonex, assistant director of the General Motors Proving Ground, suggested that automation be

applied first in commercial transport where, on a few relatively short sections between large metropolitan areas, it could be shown that automation is feasible economically. A logical place might be a few lengths of super-superhighways connecting the large cities in the east and east-north central sections. For passenger car application, we may see first rather simple forms or elements that will warn the driver of path deviation or unusual traffic situations ahead, and with the control of the car remaining in the hands of the driver. From this will come the fully automatic control to be installed in vehicles of the future for long-distance travel.

Several interested in inviting the International Association of Bridge and Structural Engineering to hold a meeting in the U.S. met for discussion. The group included, left to right, Stanley H. Fistedis, of the Argonne Laboratories, Chicago; Eivind Hognestad, of the Portland Cement Association; John Parcel, of St. Louis; James Michalos, of New York University; and Robert Moorman, of Brooklyn Polytechnic Institute.

Engineering Mechanics Division

Engineering research was called a matter of vital concern to the nation's welfare by Edward Wenk, Jr., Technical Assistant for Engineering Research for National Security, and executive secretary of the Federal Council for Science and Technology. He told a session sponsored by the Engineering Mechanics Division: "The state of this nation's security in terms of military defense, success in attaining our foreign policy objectives, and the vigor and productivity of our economy depend, now more than ever before, upon contributions from science and engineering. As a consequence, the Federal Government has had to assume significantly greater responsibilities for sponsoring programs in engineering research."

Dr. Gordon Brown, dean of engineering at MIT, said that "Without research, engineering will become an intellectual slum. . . . It is through research that we condition ourself for a forward move." Dr. Brown urged engineers as a group to support research. He stated that it should be the civil engineer who does research in new materials of construction, in the use of computers to civil engineering applications and other areas directly related to his profession.

Elmer K. Timby, Director of ASCE, called attention to the research activities of the Society. He mentioned the $100 Research Prizes (up to five) that may be awarded every year and the annual $5,000 Research Fellowship. Mention was also made of ASCE's current search for a research director. Research conferences should develop more specific, concrete suggestions for definite action, according to Mr. Timby. In describing the Society's future role in research, he called for a definite coordinated plan of action. As a suggestion for greatly needed funds, Mr. Timby recommended an additional $5 dues for every member, the total sum to be set aside for research.

Soil Mechanics and Foundations Division

Foundation difficulties and failures in the metropolitan New York area were discussed by consulting engineer Jacob Feld. In spite of the common belief to the contrary, ground conditions in the metropolitan area are considerably varied. So much so, Dr. Feld explained, that if two borings for a project investigation show identical soil-layer conditions, the validity of all the borings is questioned. The rock in the metropolitan area is erratic and irregular; far from useful for support in many cases.

It is not unusual to have a few columns in a large building supported on piles within an area where rock has to be excavated for the cellar. Dr. Feld emphasized that the small percentage of added cost for a proper, and perhaps over-designed foundation is a worthwhile investment for any structure.

The stabilization of excavation by freezing also received attention on the Soil Mechanics and Foundations Division program. Charles P. Gail, construction engineer for the Winston Brothers Company, called for more research in this field. It should be done, he believes, by institutions in cooperation with the construction industry. Warning his fellow engineers of the uncertainties concerning the behavior of underground formations under the stresses of freezing, Mr. Gail advised them that a company with experience in the field should be consulted.

On the speakers' platform for a Power Division session on the Indian Point Atomic Plant were, left to right, T. R. Galloway and W. B. White, both of the Consolidated Edison Co.; Lyle V. Larsen, of the Chicago Bridge & Iron Co.; A. J. Michael, of the J. G. White Engineering Corp., who presided; and H. L. Meyer, of the Vitro Engineering Co.

Nat Turner and R. M. Collie, of Houston (at right), had an interested audience in Charles Yoder, left, of Milwaukee; Charles Wellons, of Philadelphia; and Ed Estes, of Tampa, for a "way-out" story on Houston's 650-ft dia air-conditioned stadium.

Pipeline Division

Pipeline Division sessions were oriented to economics. Lead-off man was Charles C. Whittesley, president of Ford, Bacon and Davis, Inc., who said that pipelines are now the third largest materials carriers. When the load factor is high, the pipeline is without peer as a transportation medium. Many materials now are pumped and other things can be, but this is economical only if large quantities are to be moved. Coal, mixed with water, is being transported more than 100 miles across Ohio to a Lake Erie power plant. Experiments are being conducted in processing wood pulp during transit. He said the piping of wheat, rice, and other cereal grains is "a challenging problem for the imaginative engineer."

Thin-wall pipe came in for considerable discussion, touched off by an excellent paper presented by Jack W. Pierce, of the Southern California Gas Company. He told how costs can be reduced by use of thinner wall pipe but detailed the numerous problems that arise from such use. It was pointed out that the cost of 52,000-psi yield-strength pipe is $3.00 per ton more than 42,000-psi pipe, which provides an increase of 24 percent in allowable design pressure at an increase of 1½ percent in cost. For $2.00 per ton difference in cost of X42 over API butt-welded pipe in smaller diameters a 68 percent increase in the minimum yield strength is gained at 1 percent cost for material. Steel companies are working on alloys that will make available 80,000 to 100,000-psi yield material in the future with better chemical and physical properties.

Surveying and Mapping Division

The Surveying and Mapping Division had interesting papers, but even more important was the corridor talk on the status and even the professional survival of this branch of civil engineering. Educators and practicing engineers are greatly concerned about equitable licensing that will upgrade the work into the engineering profession, at least within a few years. This must be done without causing undue hardship among those who have been in this field for some time but cannot qualify for registration as professional engineers. Otherwise, it is expected that there will be insurmountable political obstacles to licensing of land surveyors.

Despite apparent acceptance of the necessity for surveying courses in the survey of needs in engineering education many schools continue to curtail their courses, particularly the so-called line and grade application.

John H. Wickham, Jr., executive director of the Association of Professional Photogrammetrists, reported that his organization has decided to create "certificates of special knowledge in photogrammetric engineering" to give special recognition to skills in this field. While some schools award degrees in photogrammetric engineering and some states provide registration for the specific field, there has been slow recognition of this relatively new science. Up to now the title photogrammetric engineer has been one that more or less anyone could assume. Details of this registration are being worked out.

Sanitary Engineering Division

Research, a recurring theme throughout the Convention, was also featured in a program sponsored by the Sanitary Engineering Division. A special report to the Division by the Research Committee called for more objective coordination of research efforts taking place in the sanitary engineering field. A threefold increase in the nationwide air-pollution research effort by 1968 has been called for. This would amount to an annual expenditure of some $30 million, and it was recommended that the work to be done be supported by all levels of government and industry.

Other areas in which research is badly needed are:

1. Solid wastes, including further study concerning sanitary landfill as well as applied engineering methods for refuse collection and transfer station systems, disposal after grinding to the sewerage system, and composting.
2. In studying stream pollution,

Snapped at the Civil Engineering Show were Past President Enoch Needles, of New York; R. N. Bergendoff, of Kansas City; Don Mattern, ASCE Vice President from Knoxville; Edmund Friedman, of Miami; and Dean Frank Kerkes, of Michigan College of Mining and Technology.

suggested areas of research ranged from the development of physical models for prediction of stream self-purification rates to the disposal of concentrated brine from saline-water conversion plants.

3. For the industrial waste field it was suggested that emphasis be placed on increasing waste water treatment process performance and upon evaluating the efficiency of various unit operations with regard to the destruction or removal of specific waste components. Another area of research needed is that of developing processes and systems which permit continuous direct reuse of urban waste waters.

4. Finally the general field of water resources was described as in need of research in the following areas: Economic comparisons of saline water conversion and alternate methods of increasing water supply; consumption versus use of various water supplies; and emergency decontamination of public water supplies exposed to radioactive fallout from nuclear explosions.

The Chi Epsilon Room in ASCE Headquarters was dedicated during the ASCE Open House on October 19. Representing ASCE and Chi Epsilon Fraternity, which raised funds for furnishing the conference room, were (seated) Harold T. Larsen, counselor emeritus; William H. Wisely, Executive Secretary ASCE; and Paul Hartman, national president, Chi Epsilon. Standing are Hunter Rouse; Sam Kramer, national chairman of the campaign committee; John Focht, national secretary treasurer; Jerry Palevsky, president, New York Chapter; and Don King, treasurer of Chi Epsilon Room Fund.

Power Division

The Power Division presented a full day of papers on pumped storage covering major projects in this country and abroad. Exceptionally well attended meetings, even on the last day of the Convention, confirmed the high interest in this subject. A session on high-voltage transmission lines and one on the Indian Point Atomic Power Plant of New York's Consolidated Edison Co.—with a trip to the latter—made the Convention of special value to those in the power field.

Almost every hydroelectric project planned today is considered for pumped storage possibilities, said Richard Harza, of Chicago, in a paper on foreign projects. New ideas and even new words have come into the field. Water is being made to flow uphill—profitably. The greatest area for this development is Europe, but Japan, Russia and others are active. Projects in the Alps are for seasonal storage generally while those in low areas are for daily or weekly peaking. Europe's smallest country, Luxembourg, will have the world's largest pumped-storage plant, when a 400-megawatt plant goes in operation in 1964 to be followed by a 500-megawatt addition. Energy is from a lignite-fired steam plant raising water 980 ft. Other heads range up to 4,150 ft. To date, separate pumps greatly outnumber reversible pump-turbines.

"Reversible pump-turbines are the hydraulic turbines of the next period of development of hydraulic power," said F. E. Jaski, of the Allis-Chalmers Manufacturing Co. Few conventional hydropower sites still are available. Pumped storage, perhaps in connection with atomic power, offers good possibilities. New developments for high head pump-turbines make this type of power practical near many centers of load.

During the past five years, 17 of the largest U. S. construction companies completed almost $2½ billion worth of work overseas. This volume generated over $1 billion worth of U. S. exports and gave employment to about 4,000 overseas employees and a much larger number of people domestically. This was the statement of Gerald A. O'Connor, vice president of Raymond International Inc., before a Construction Division session. Foreign competition is having a significantly greater impact on this business, and the volume of overseas work done by U. S. contractors is shrinking each year. European firms are competing for business in the lesser developed countries. They do not surpass the American company in construction techniques or concepts, but rather in the fields of business and finance where they combine engineering with construction to develop overseas business.

Structural Division

Structural Division papers concentrated on connections for steel and for precast concrete members. Bolts and rivets for joints and fatigue of bolted and welded connections were covered in eight papers on steel. Edward R. Estes, Jr., chief engineer of the Florida Steel Corporation, and formerly with the American Institute of Steel Construction, told one session "It now becomes apparent that shop bolting is attempting to replace shop welding." Research studies showing no reduction in beam strength when high-strength bolt connectors are used mean we will certainly see more shop bolting regardless of whether or not a job previously would have been riveted or welded.

New high-strength bolts and new specifications governing their use have given greater emphasis to bolt use in shop fabrication. Proper design may result in fewer bolts being required than rivets as a friction-type connection eliminates the need of limiting bearing stress on a thin connected part. Cost studies show shop bolting is definitely competitive with shop riveting. Shops that have no riveting facilities but fabricate on the basis of shop welding and field bolting find that it is no more expensive to punch for shop bolting at the same time.

Six papers gave details on design and construction aspects of structural connections in precast concrete, and one was devoted to timber connections. Current applied research underway in many college laboratories and by other groups was briefed in eleven papers in one three-hour session. Many of these papers, as well as others from all sessions of the Convention, will appear later in publications of ASCE.

(More ASCE News on page 72)

Construction of the New York World's Fair

WILLIAM E. POTTER, F. ASCE, Maj. Gen., USA (ret); Executive Vice President

WILLIAM WHIPPLE, Jr., F. ASCE, Brig. Gen., USA (ret); Chief Engineer

World's Fair 1964-1965 Corporation, Flushing Meadow Park, Flushing, N. Y.

The New York World's Fair will be a glamorous city of some 200 buildings, costing $500 million, with 28 miles of paved streets and sidewalks, served by a power source of 80,000 kva and a water system of 35-mgd capacity. It must be built and ready for occupancy in four years—and disappear entirely in three months after it closes.

Full though it may be of lights, fountains, glamour and fantasy, a world's fair is still an extraordinary example of engineering in action. Like any city, it has its sewers, roads and electrical systems, and like any city, the facilities furnished must meet the high standards of safety and public health that the most modern communities require. It has a building code and a health code. It must be clean—and hence capable of being kept clean. It must meet underwriters' requirements and hence be served by fire prevention and control facilities. From the point of view of public works, it is complete. It is a city with no resident population, but capable of supporting, on some days, a very large number of people.

Perhaps the best way to describe the problems of a world's fair in comparison with those of a normal city is to say: They are different! Possibly no other type of peacetime effort must be readied in so short a time. When one considers that the construction effort will be by multiple, uncoordinated contractors, the job appears even more complex.

Organization

Heading the organization for the New York World's Fair 1964-1965 is Robert Moses, the country's greatest doer and organizer. The methods that are used here have been developed by him over decades spent in planning and managing some of the country's largest construction jobs.

The "sale" of space is supervised by two vice presidents, the engineering by the chief engineer, and the planning for operation of the Fair under a vice president for operations. The concept of organization is perhaps one of the most interesting parts of the story: the 1939-1940 fair employed roughly 6,000 people; this Fair will have about 160. In the last fair, the chief engineer had an organization of some 600 people; in this Fair, he will have about 20. Obviously, the number of people working will not be very greatly reduced, but the method of procurement will be entirely different.

Service by contract

Every possible service for the 1964-1965 Fair will be by contract. For example, the police, fire fighting, first aid, and hospital staffs have been contracted for with the Pinkerton organization. All maintenance will be performed by Allied Maintenance. All engineering is contracted to private firms now doing business in the metropolitan area. The Fair is thus relieved from the organization and staffing of a considerable force, from the establishment of a large recruiting organization, and from training and maintenance of the organization. The great savings so realized are immediately obvious. Administrative control is maintained through supervisory officials whose function is to assure efficiency at the least cost in manhours. The function of the Fair's own employees, the 160 mentioned above, is to supervise highly competent, proven organizations during the operational years.

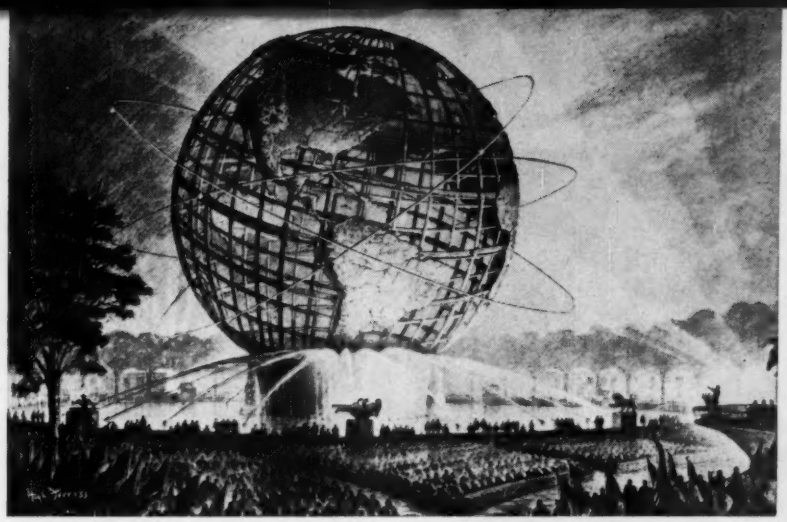
Planning any entirely new enterprise must start with assumptions and objectives intuitively derived. These are transformed by successive applications of engineering science to their logical consequences in terms of time, space and money. Along the way many ideas must be discarded or replaced. Because of this planning, we are able to say that there is no such thing as an undesirable location at the Fair. Each lot will be very adequately served by transportation; each will be close to Fair-built fountains, pools, and parks; each will be assured that it is on an avenue that the public will automatically use. Nobody will be in the back woods.

The World's Fair planning is like city planning, however, in that the final result will depend on the initiative of many different persons and organizations, whose plans will only gradually be developed. About 250 exhibitors and other participants will do the greater part of the construction.

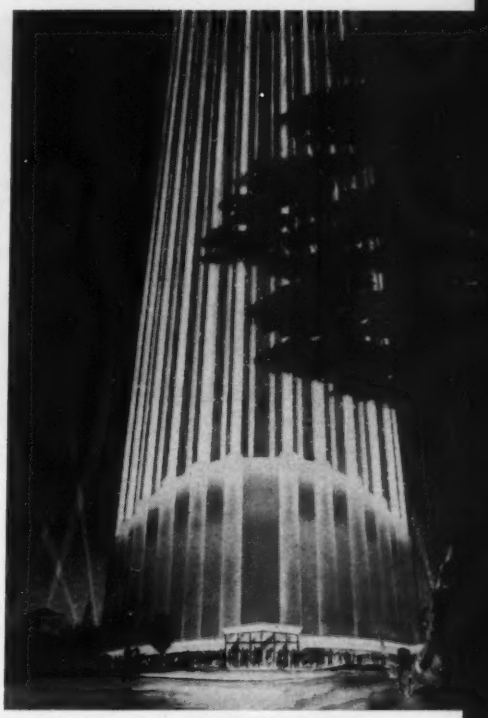
In view of the planned size of the Fair, it was evident that even New York's large supply of construction labor might run short if construction were compressed into a couple of years. Accordingly, basic construction is to be completed by June 1962, including the main road and utility systems, leaving exhibitors almost two years free of restrictions or complications to complete their exhibits. See Fig. 1.

Utilities problems

Planning of utilities presented a good many problems, as the timetable did not allow waiting until exhibitors could indicate the size and nature of their exhibits. Projected attendance figures had been worked out as a total of 70,000,000 people, with something over 500,000 as the daily peak. Comparisons were available with other large fairs, particularly with that of 1939-1940 in New York. The Brooklyn Union Gas Company and the New York Telephone Com-



Unisphere, theme center of the New York World's Fair 1964-1965, will be built and presented to the Fair by United States Steel Corp.



A world's fair is a paradise for architects and imaginative planners. This is the projected exhibit of the Electric Power and Light Companies.

pany agreed to provide services at the Fair and merged their planning effort with ours.

Many things have changed in the world since 1940, but the basis of estimates for toilets remains unchanged. Thus the sanitary sewers could be planned with confidence. Storm drains also were simple, depending mainly on road layouts and topography. (To save trees few changes in elevation are being made.)

New York City agreed in the basic lease to furnish all the water required without cost. However, this treated water will be conserved, in accordance with normal city conservation practices, by recirculation in fountains and other water displays and in cooling towers for air-conditioning. The basis for water use envisaged a period of maximum use of air-conditioning of 5 million sq ft of enclosed space, with other needs based on 400,000 persons attending the Fair on that particular day. This results in a system demand of 35 mgd.

Telephone service requirements are being planned by the New York Telephone Company, which has shown a great interest in the Fair. The Fair Corporation will provide the necessary conduits; these are being installed along with other utilities, the cables to be placed later. The need for an unknown number of electronics circuits for television and data processing was solved practically by including additional conduit paths even though the actual circuit requirements will probably not be known for another year.

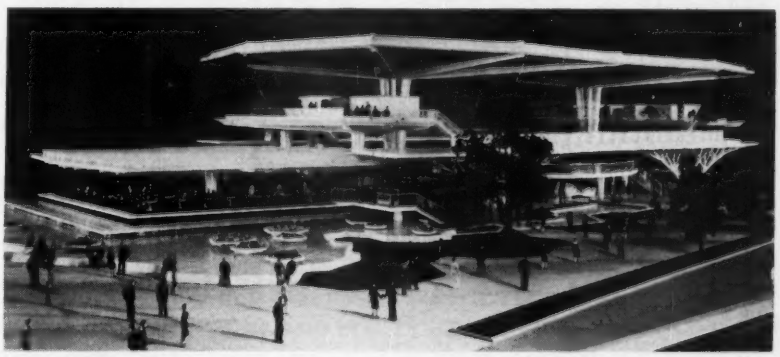
The most complex, and by far the most expensive, of the utility services is electricity. The area is served by the Consolidated Edison Company, and three-phase current will be made available at 27,000 v at a nearby substation. Electric conduit in the initial contract cost $2,600,000; the entire system, including three substations and a distribution network of 4,160 v, will cost about $7,000,000 for a normal capacity of 80,000 kva.

A special situation was presented by air-conditioning. While gas will be provided throughout the Fair by the Brooklyn Union Gas Company at normal commercial rates, and at no cost to the Fair Corporation, the amortization of the electric distribution system will require considerably higher than normal charges for electricity. Thus the situation will be more favorable for gas air-conditioning than is normally the case in the New York area. Load planning was based on the assumption that a major part of the air-conditioning would be by gas.

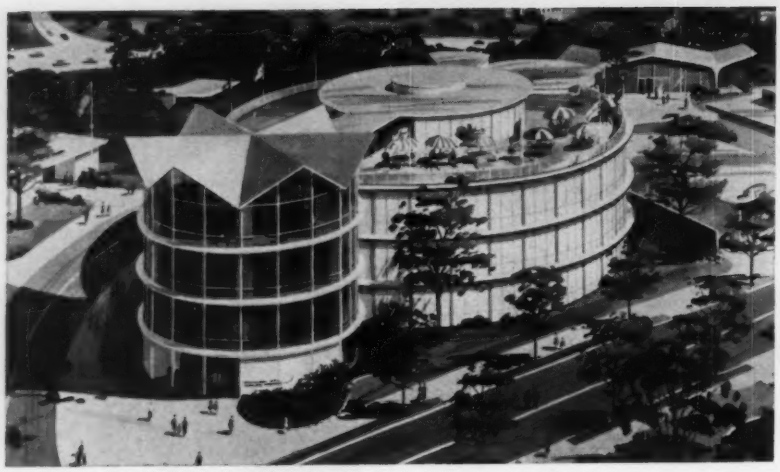
It was expected that many of the underground utility lines from the 1939-1940 Fair would be usable. Water mains are largely cast iron and are usable, with new service lines, where they are in the right location. Sewers generally can be used. Streets are lined by trees that have grown useful and generally have established the pattern for the new Fair grounds. Electrical conduits now needed are different in size, shape and location from those used for the earlier fair on the same site. These and the telephone conduits are being replaced.

Building standards and architecture

Almost all the buildings in the Fair will be of temporary construction, although they must be sturdy enough to withstand one winter. Originally the design of roads and utilities was projected on a similar basis. However, it was finally decided that the City of New York would contribute to the Fair Corporation $24 million worth of



Wallless gas-industry exhibit has an air curtain between the stilt-supported roof and the floor to protect its gas air-conditioned interior.



Pavilion of American Interiors follows the modern trend shown in the U.S. exhibits. Preliminary sketches indicate that many novel ideas are being developed.

Table I. Engineering and architectural consultants

Nature of Work	Firm
Roads, bridges, parking fields, bus terminals	Andrews & Clark
Electrical work	Syska & Hennessy
Water supply and sewers, cleaning lake water	Hazen & Sawyer
Telephone and electronics conduit system	New York Telephone Co.
Landscaping, fountains, sculpture	Clarke & Rapuano
Spectacular illumination and lighting of grounds	A. K. Morgan, J. S. Hamel, D. Oenslager
Examining engineers for code enforcement	Purdy & Henderson and Eipel Engineering
Soils and foundation studies	Moran, Proctor, Mueser & Rutledge
Waterfront development	Tippetts-Abbett-McCarthy-Stratton
Security Building	Brown, Lawford & Forbes
Rehabilitation of the amphitheater	Lorimer-Sears & Kopf

construction, representing improvements of permanent value. Such structures are being redesigned to permanent City standards. This includes almost half the construction program of the Fair Corporation.

The far larger construction program of the exhibitors will be strictly temporary. A special Building Code, adapted from that of New York City, has been approved by the City. It will be administered by the Fair Corporation in the interest particularly of public safety. Certain other rules have been adopted, governing such aspects as height of buildings, setbacks, and control of sound devices, but generally speaking little control will be exercised over the architecture. Within the bounds of good taste, exhibitors are given carte blanche.

A world's fair is a paradise for architects and imaginative planners. Hundreds of fine clients, including top American industries and many foreign nations, must compete in the attractiveness of their displays, disregarding the routine and mundane, and giving free rein to the imagination. Preliminary sketches of exhibits displayed so far indicate that many novel ideas are being developed. Structures following architectural themes of the past are virtually nonexistent so far as current presentations of U. S. exhibitors are concerned. No doubt some of the foreign exhibitors will utilize more traditional forms; it is hoped that they will, to convey the atmosphere of their older cities and regional cultures. Similarly we hope for regional themes from some of our own states.

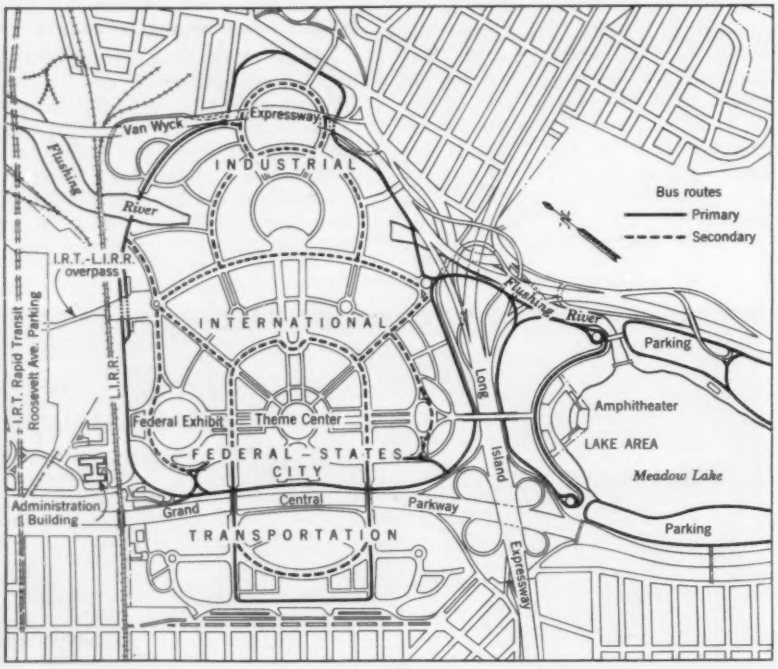


FIG. 1. Theme center forms core of Fair's central area.

Transportation is important

As far as engineering is concerned, the major problems of the Fair lie in the field of movement and transportation. Planning in these fields was early and vigorous. Main highways, railroad and subway approaches are shown in Figs. 1 and 2. Besides the Throg's Neck Bridge, $112 million in new or widened highways leading to the area was found essential and has now been programmed for the Fair. These roads are needed for the area in any case, and without them there would be chaos in 1964. Fortunately, commuter peaks do not coincide with the hours at which most people will enter and leave the Fair, but heavy week-end movements in summer certainly do.

Parking for 20,000 cars will be provided by the Fair Corporation. This is less than desirable, but additional space would be too far away. In addition, parking will be available for about 200 tour buses. Free shuttle buses will bring visitors from the parking fields to the nearest entry gate.

The Fair grounds are served directly by the Long Island Railroad, which is cooperating fully in the

planning. Since heavy freight movements are anticipated during the construction and demolition periods, a temporary siding for 20 cars will be built on spaces provided by the Fair. The passenger terminal will have three station tracks; and stairs will lead directly to an overpass structure, originating at the nearby subway station, as shown in Fig. 1. This overpass, it is estimated, will be used by 51 percent of all visitors to the Fair. About 40,000 sq ft of usable space in the structure will be available for various administrative purposes, including customs offices.

With the Fair itself, transportation services will be provided by Greyhound. Buses of conventional type will circulate around the periphery of the Fair utilizing roads generally free of major pedestrian movement. Other roads in the Fair will be served by tractor trains carrying a large number of people at a slower rate. Supplementing these will be electric vehicles similar to golf carts, which can carry a guide and up to four persons, moving on all interior roads and sidewalks. Finally a moving sidewalk will connect the lake area with the rest of the Fair, and a cable ride will be available.

Foundation conditions

Although topographically ideal for a Fair, Flushing Meadow Park presents certain foundation problems. The area is an old estuary that has been filled with marshy deposits of soft clay and silt extending in most areas 50 to 80 ft below the surface. The Transportation Area, which is on higher, solid ground, is the exception. See Fig. 1. The greater part of the area has been filled in with heavy cinder deposits generally sufficient to support light buildings on spread footings. The one-story Administration Building of the Fair Corporation was built in this manner and in a year has settled an average of 2 in. For heavier buildings—and indeed for light buildings in certain areas—piles are required even though the structures are temporary.

One of the difficulties of building in a metropolitan area is the high cost of obtaining suitable fill or of disposing of excess unsuitable material. To provide fill, an arrangement has been worked out with the City of New York whereby 700,000 cu yd of burned incinerator residue will be made available to the Fair Corporation at a nominal cost. This residue, when properly compacted, makes very satisfactory fill. Also, some fill is available from nearby highway work.

Considerable thought has been given to disposing of the soft organic sludge removed from Flushing Creek. Temporarily it will be spread in thin layers over parts of the grounds not involved in construction. After it has dried out and weathered for a number of months, it should be possible to incorporate it in the topsoil. If this proves impracticable, it will be hauled away for disposal, but its weight and volume will have been much reduced.

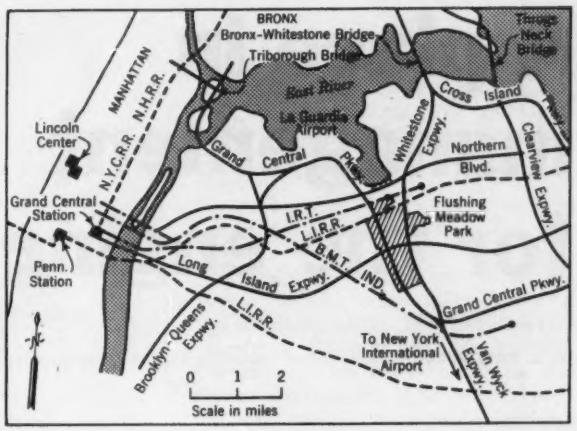


FIG. 2. Many transportation facilities serve Flushing Meadow Park, site of the World's Fair 1964-1965.

Waterfront improvement

The improvement of Flushing Bay waterfront, about a mile north of the Fair, will provide access for the many who will come from Manhattan by excursion boat, as well as for the innumerable private boats using Long Island Sound. The existing marina will be more than doubled in size and in future two additional marinas will be required for small boats in the area.

Dredging and some realignment of the channel is required to serve commercial as well as recreational water traffic. The total cost of this program will be about $5 million, of which $1 million will be met by the World's Fair, about $2 million by the Federal Government for dredging, and the remainder by the City. Motorboat displays and exhibits may also be conducted here.

Construction schedule

The main construction program of the Fair Corporation is now well under way. The Administration Building was built in 1960 and certain minor features of work of a preparatory nature were accomplished in the Spring of 1961, including the moving of 150 sizeable trees. A list of engineering and architectural consultants is given in Table I. Engineering and architectural planning are on schedule for other items. Major contracts let to date are given in Table II.

Assured now of financial backing as well as of top leadership, preparations for the greatest World's Fair in history are already in high gear. When the Fair is over, all buildings will disappear except the Unisphere, some of the fountains and lighting, and perhaps the federal exhibit. New York's legacy will be a planned modern park to serve the needs of an ever-expanding community.

Table II. Construction contracts awarded

New York World's Fair 1964-1965 Corporation

Nature of Work	Bid Price	Engineers, Designers	Contractor
Utilities and streets	$ 4,625,000	Andrews & Clark	Slattery Contracting Co.
Electrical	2,945,000	Syska & Hennessy	Johnson Electrical Corp.
Observation Tower	27,130	Andrews & Clark	Slattery Contracting Co.
Administration Bldg. (not including landscaping)	1,268,188	Skidmore, Owings & Merrill	James King & Son, Inc.
Additions to Admin. Bldg.	135,000	Wilcox & Erickson	James King & Son, Inc.
Transplanting trees	66,869	Clarke & Rapuano	Frost & Higgins Co.
Grade Kissena Corridor	102,400	Clarke & Rapuano	Tully & DiNapoli, Inc.
Clearing botanical gardens for constr.	10,984	Clarke & Rapuano	Roman Landscaping Co.
Pruning, guying, cabling	32,635	Clarke & Rapuano	Bartlett Tree Expert Co. and Roman Landscaping Co.
Electric distribution system, cables & substations, Phase 1	1,528,246	Syska & Hennessy	Eastern States Electrical Contractors, Inc.

A place in management for the engineer

W. L. PATTERSON, Black & Veatch, Consulting Engineers, Kansas City, Mo.

If the engineer can be made aware of his potential in management he will realize benefits, and his employer, business associates and clients will also benefit. The engineer has characteristic qualities derived in part from his training but also likely to be inherent in the type of individual who chooses engineering as a career.

An engineer must first be a student of no mean ability. Through training and study he is likely to place his confidence in methods, formulas, and technical knowledge and experience, rather than in new ideas or in matters involving people and management. In his early years, he may resemble a technician more than he does a professional man. He may be inclined to carry out his work assignments by rule and precedent, and according to very definite instructions. It is often disturbing for him to find that his supervisor does not have a clear answer to every problem.

I am referring now primarily to the engineer in consulting practice. Actually, the same principles of management applicable to larger and more complex businesses apply to the conduct of consulting engineering work. The consulting engineer, to be successful, must be a good manager and business man. Further, the application of business principles is not limited to the top of the organization but must prevail throughout to a considerable degree. Consulting work is a business; it must have more income than outgo if it is to survive.

Quality and dispatch

In engaging a young engineer for our work, we inform him that in addition to the basic characteristics of ability, character, honesty, personality, etc., there are two qualities that actually will be the measure of his early success or failure. The first is that work accomplished must be of good quality, free from errors, well executed. The second and equally important requirement is that it must be executed with dispatch. The quantity of work accomplished has a very important influence on our judgment of a young engineer—in deciding whether he is worthy of advancement or not.

It is self evident that the man who can complete his assignment the earliest, and do so consistently, must be a good manager of himself and of his own efforts. The ability to size up an assignment, organize it and execute the work with intelligence and speed is an ability the organization is looking for. If the young engineer views assignments as a succession of tedious tasks, his progress may be difficult.

Successful management of individual effort requires well known but not always well observed characteristics of interest, promptness, planning, determination, and continued effort. As a young man, I was assigned to our drafting room. We were not very highly organized in those days and there was little classification as to job assignments and duties. I had been engaged as a designer, and following the comprehensive design of a small but complete plant, I inquired as to arrangements for detailing plans. I was asked if I could do this and found that if it was to be done, I would have to do it; I did. When the detailed sheets were ready to be traced on linen cloth, I was asked if I could trace, and that solved the tracing problem. This procedure made a junior engineer do some thinking. The set-up of a one-man team, while necessary at times, did not appear to me to be an efficient operation in this case.

Then, with reference to a certain engagement, the head of the firm announced that "we always lose money on the job in the drafting room." That remark helped to make one junior engineer cost and management conscious. It is evident that the production of designs and plans and the general organization of an office can be a profitable or a losing proposition based on the performance of the engineers and assistants, and the organization of the work. It is surprising to find that a large proportion of engineers are far from cost conscious.

Efficient production a "must"

Perhaps the most difficult thing for a young engineer to learn is that there is a scheduled performance for today, tomorrow and every day, and that unless the production schedule is met there will be little real advancement for the group—or for the individual.

In our firm we inform the new employee early that we are on the lookout for the producing engineer. After a break-in period of a few years, those who measure up are put in the second echelon, given some responsibility and a job title. Duties include the basic management of a unit, or squad, and we designate the leader a Project Engineer, Field Chief, or similar title. The job leader is essentially responsible for the work of the group and is also the job manager. He designates assignments of personnel, schedules the work to meet the completion date, maintains work standards, and furnishes assistance to the principals involved. Often, he handles relations with the client's organization, particularly at the operating level.

If the job leader is to succeed in his assignment, he will need to adopt a broader approach to the group effort than he as an individual engineer would normally have. To his initial dismay he will find that he must spend a great deal of his time in arranging assignments, answering the questions

of others, setting up work methods and giving instructions. He will find that job management requires coordination of effort. Some parts of the work will fall behind estimates while other parts will forge ahead. There will be disagreements and conflicts in personalities. Another frustrating experience is to find that it is the rule rather than the exception for changes to be required, and these will often involve the redoing of large parts of the work.

A job leader is fortunate if his initial assignments are limited both in the scope of the work and in the number of people engaged on it. He will have difficulties if he is thrust into large responsibilities too early.

Let's take a look at the next level of management in a consulting engineer's organization. Assume a line type of responsibility in which the job leader, or project engineer, is directly responsible to the principal engineer. The principal has full responsibility for the engagement. If the project fails to meet the schedule or to measure up to standards, or if it costs too much, the principal must take the responsibility. The principal is generally a senior man both in years and in experience and his judgment regarding management methods may be on the severe side because of the many lessons he has learned the hard way.

On the principal falls the responsibility for the overall organization of the work. This entails outlining, examining, and estimating its scope, the methods to be employed, the extent certain problems are to be pursued, schedules of delivery, relations with the client, and cost control. An adequate project engineer or job leader will undertake much of this work for review by the principal. The Project Engineer who organizes the work and presents it for review successfully makes a valuable contribution to management as a team member.

Members of the working group must remember that the principal has two "bosses," first and most important, the client, and second, his own business organization. Here he is generally responsible to the head of the organization, which may be represented by a manager, an executive committee, or a board of directors.

The head of the organization—whether he carries the title of president, manager, or chairman—is responsible for the combined activities of the various groups, one of which we have described. His work is essentially administrative in character. In addition to supervising the principal engineers, he must oversee the work of the managers of staff functions such as design, special studies, construction, accounting, transportation, reproduction, stenographic, and personnel. He also is vitally interested in client relationships and contacts.

Opportunity versus seniority

What sort of organization will offer the best opportunity to the young engineer who hopes to make a contribution to management? Let's take a typical successful organization, which has grown rapidly from a small beginning several decades ago, with two original partners. For a decade or more about six or eight principal assistant engineers with a substantial staff of designers, draftsmen, resident engineers, surveyors and clerical assistants, made up this typical organization. Outside of the principals and the principal assistants, few titles were assigned to personnel.

As the firm grew, changes came about. Through variations in ability as well as for other reasons, the original group diminished and new individuals took their places. Principal assistants became principals, with principals' powers, since it became evident that the two original partners could perform little more than overall management of the numerous engagements involved.

During the growth years, the organization may be reluctant to give specific titles to many very capable engineers. Instead, individuals are given definite responsibilities for a given engagement. The individual is aware of the fact that his progress depends on his performance on the given engagement. With good results he will receive more important assignments but with continued lack of success he may move down the scale, or even out of the organization. Titles have little to do with real progress and can be a deterrent to the application of a plan for professional development.

If an organization tells a young applicant for a professional position that it does not recognize seniority as such and he has the right attributes, will it not appeal to him as offering good opportunities for advancement? On the other hand, if he is a weak man of mediocre ability, he will realize that he may not achieve security or seniority advancement under such policies, and he may seek employment in other fields.

In the past decade, young engineers have increasingly requested that job titles be defined and that job duties be clearly spelled out. Many organizations have endeavored to meet these demands but I caution the individual who seeks too definite a clarification on job classification that he may harm himself in restricting his field of effort. There are occasions when job titles may make it impossible for management to move a promising young engineer to a higher slot on the organization chart on an assignment or trial basis. If you were the engineer involved, wouldn't you rather have the latitude of freedom of assignment?

Initiative rates high

Let's talk about the development of initiative. If there is any one quality that a management candidate must have above all others, it is initiative. Initiative is the developed trait that allows a man to free himself of dependence on supervision and to choose the path he or his group is to take in the execution of an assignment. Initiative must be exercised by the individual in work at all levels above the routine or clerical. Lack of initiative often results in the use of methods that are simply repetitious, or it can even re-

sult in failure to find a solution or to make progress in executing the work.

The proper use of initiative applies the benefits of experience to the needs of the engagement at hand. Initiative is the source of independent, original thinking. An "idea" man is a valuable member of the team, and if he has the other necessary attributes, he will achieve a high degree of responsibility —and success.

In any organization policies and procedures are furnished by superiors. Often an organization engineer will say, "I don't know why we follow this method but they will tell me if it is to be changed." In my opinion, it is better for him to question methods and procedures, and to bring forward, on his own initiative, ideas for improvement that he sees at his level of the operation. Of course, on scheduled assignments and under pressure, a junior man's ideas are not always well received. But my advice is to get his ideas to the responsible managers; and if they are sound, recognition can be achieved. It is a well known fact that the junior engineer who expresses too many ideas had better be sure that they are sound, and realize that his neck is out. In our organization, we welcome the man with ideas and the courage to promote them.

What does the manager do?

What are the duties of a manager? The American Management Association has published as a research study a volume defining the job of manager. From this study, we will briefly summarize the responsibilities generally listed by large organizations as pertaining to those engaged in management.

The manager has a continuous planning and scheduling job covering the work of those reporting to him. He plans personnel requirements in advance and sees to it that subordinates are similarly planning for the future.

He assigns responsibilities and delegates authority to those in his group. He reviews the situation periodically to determine whether the delegated responsibilities are being satisfactorily discharged.

He guides those who are under his direction. He is responsible for their loyalty to the organization and encourages such loyalty.

He recognizes good performance and takes steps to improve poor performance. He recommends promotion, salary adjustments and disciplinary action or changes in personnel as required.

He is responsible for the improvement of work methods and the reduction of costs, as well as the maintenance of quality. He brings up suggestions to the organization regarding new equipment, methods and changes in organization to benefit future work. He keeps the organization informed of developments in his group and keeps those reporting to him informed of anything he finds out that will be helpful to them. He keeps other management members informed on the work of his group.

The man in management continually attempts to improve his leadership, his initiative, judgment, dependability and enthusiasm. He values personal integrity. He is conscious of customer relations and public relations, and takes every opportunity to improve both. He prepares reports and correspondence. He studies pertinent reports and acts on them in the best interest of the organization. He also promotes new procedures that will improve the production of his group.

The exercise of management is necessary in varying degrees from the top to the bottom of engineering work, at the professional level. Recently I read a statement by a well known and respected engineer in which he warned engineers not to lose their professionalism by accepting the obligations of management. I believe his reasoning, in the particular case, was that by subscribing to the discipline of management, particularly by lay people, the engineer could well lose his professional position. Of course management decisions must never supersede professional ethics and practices. But the engineer will be more effective if he realizes that he cannot successfully remain in an ivory tower. Responsibility, and success, will follow if he supplements professional excellence with management attributes.

The professional engineer often does not realize that there is a lack of leaders in management with the integrity, experience and training of the engineer. Consequently there is a need in many phases of management for direction by the professional engineer rather than by others not so qualified.

Clients need advice

In consulting practice, by its very nature, the client looks to the engineer for more than purely technical advice. This tendency on the part of clients has become much more pronounced in the past decade. The growing complexity of industry and of governmental agencies has brought about a need for specialized assistance to a greater degree than formerly, when such activities were simpler and on a smaller scale. The client now may call on the consulting engineer not only to design an electric station but to set up a plan of action or a program to meet future needs, with the costs to be incurred, the timing of such costs, and an advantageous method of financing. Such studies are of great assistance to management and provide data and programs which a given management may lack the experience to develop for itself.

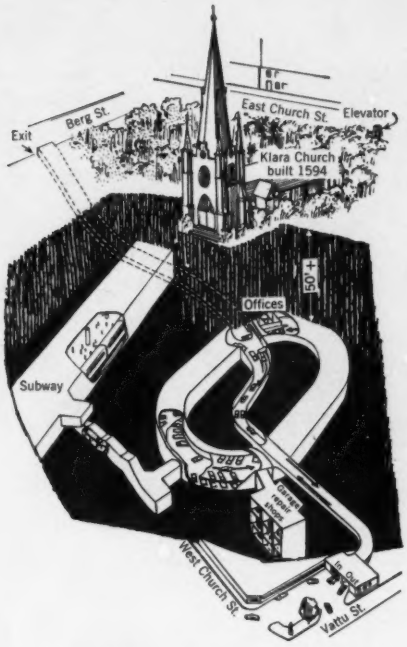
As engineers we are called upon to study not only the programming of physical change with all that it implies, but often operating problems as well. Methods of work, changes in personnel, equipment and organization may be studied as an aid to management. An intelligent study by an independent consultant may be invaluable to management where local forces are not available, or sufficiently free of obligations, to make an adequate analysis of current or impending problems.

Engineer's "know-how" counts

The role of the engineer as an aid and advisor to management is growing. Management must seek advice from a number of sources including engineers, accountants and lawyers. For business and financial records, the accountant's assistance is needed. The lawyer is of course an important advisor. In addition to handling legal problems, he often takes leadership in management. Not only his knowledge of law but also his training in evaluating and presenting situations have proved valuable. As for the engineer, if he has reached maturity and has passed beyond the purely technical phase of his development, there are many situations in which his knowledge of physical facts, processes, methods, equipment, construction and other operations is essential to management. His mind is basically practical and analytical, and if he is management conscious, his talents become invaluable.

The dependence of government bodies on sound engineering advice and planning is a large subject that can only be mentioned here. The engineer's role as an advisor to private management in specialized fields is another broad subject. There is also the role of the staff engineer in industrial and public management as differentiated from independent practice.

I believe that the increased recognition given the professional engineer today is in acknowledgment of his "know how" and "know why" in getting things done. If the individual engineer continues to follow up his opportunities in management he will gain increased recognition not only for himself but for the entire profession.



In Stockholm a shelter excavated 50 ft underground serves as a garage.

A bomb and fall-out protection system as seen in Sweden in February 1959 and July 1961

SHELTERS in Sweden

ODD ALBERT, M. ASCE, State Chairman, Committee on Civil Defense of New Jersey Society of Professional Engineers
Assistant Professor, Monmouth College, West Long Branch, N. J.

Sweden is doing something about protection from nuclear war. The building of bomb shelters was started there over twenty years ago. To-day there are enough shelters to effectively protect 34 percent of the total population of more than seven million. Shelters are being built at the rate of 2,000 a year, or 150,000 shelter spaces yearly. In general, they are planned for some quickly convertible peacetime use—such as garages or recreational areas—and are promptly put to use. Shelters are of two general types, "normal" and deep-rock.

In the revised Swedish Civil Defense Law of July 1, 1960, it is specified that, in communities of over 5,000 people, all buildings with the exception of one-family homes must be equipped with properly designed so-called "normal shelters." These are placed inside the cellars when practicable. The owners of the buildings pay the cost. Construction requiring shelters includes: apartment houses, office buildings, industrial buildings, factories, hotels, schools, hospitals, municipal buildings, police and fire stations, water works, power installations, and the like. The rules governing the size of the shelters vary for each commune and depend to some degree on the planned people-intensity.

In the 14 largest cities and in certain important communes, planners of new buildings are not required to build shelters in their cellars. The reasons are that: the risk of attack is very great; it is desired to have the non-active population out of the way; existing buildings are of such a type that they are expected to collapse and burn at and after an attack; life would be almost impossible in normal shelters with fires raging all around. However, the law prescribes that all new buildings in the area surrounding these places must have their normal shelters designed to take an overload of people. It is planned to move 90 percent of the population of such critical places to the surrounding areas. It is estimated that about 10 percent of the population will be required to take care of operations needed during a state of emergency, and to protect this 10 percent large deep-rock shelters have been built or are being planned. The cost of these

Interior of an underground shelter. Ventilation system clears gasoline fumes for garage use or provides filtered air for shelter. ▶

A water treatment plant is underground in atom-war-fearful Stockholm.

TABLE II. Deep-rock shelters for civil defense personnel

	1950-1959	1959-1961	TOTAL
No. of shelters	65	14	79
Total cost	$10,200,000	$2,800,000	$13,000,000
Cost per shelter	$157,000	$200,000	$165,000

TABLE III. Mass shelters in rock

	1951-1959	1959-1961	TOTAL
No. of shelters	14	1	15
Persons sheltered	105,000	10,000	115,000
Total cost	$20,000,000	$1,200,000	$21,200,000
Persons per shelter	7,500	10,000	7,650
Cost per shelter	$1,430,000	$1,200,000	$1,410,000
Cost per person	$190	$120	$184

shelters is shared by the commune or city and the state.

Each city and commune is also required to provide safe shelters for special units belonging to local and state civil defense personnel, also safe observation places.

These shelters are built to be fairly safe against all kinds of bomb attack. Some are deep-rock shelters; some are of heavy reinforced concrete with roofs and walls 3 to 4 ft thick. In case a commune provides shelter for water works, gas or electric installations, it may ask the state to share the cost of such installations.

Present status of shelter construction

About 32,000 private normal shelters have been built into new buildings since 1945. See Table I. These have a total seating capacity of 2,200,000 persons. Every year about 2,000 more such shelters are added to take care of an additional 150,000 persons. The total cost of these shelters, about $50 million, has been paid by the owners of the buildings.

Since 1950 a total of 79 safe deep-rock shelters have been built for civil defense personnel. See Table II. Their cost is shared jointly by commune and state, the state contributing two-thirds of the cost.

In the central areas of strategically important cities, 15 large mass shelters in rock have been completed since this construction program began in 1951. See Table III. For long periods several of these shelters were under construction simultaneously. These shelters have a coverage of at least 50 ft of solid rock and in many instances up to 70 ft. They are considered safe against any kind of attack.

The rock shelters are planned for immediate peacetime use. It has been estimated that they have an average peacetime value of 30 to 40 percent of the building cost even when wartime equipment and rooms reserved for extra mechanical equipment are taken into account. The remaining cost, 60 to 70 percent of the building cost, is so shared that the commune pays one-third and the state two-thirds.

Actually it has been estimated that, if no extra equipment were included, and if all the rooms could be used, these shelters would represent a peacetime value of 90 percent of the total building cost.

Normal shelters

The conception of a normal shelter is associated with the protection an ordinary cellar can offer. The first shelters, made on a provisional basis, were created in 1939-1940 by strengthening existing cellars and making them gasproof. This type of shelter has now been completely abandoned for new buildings and replaced by permanent cellar shelters of reinforced concrete.

The building of shelters is well organized and has been kept in line with new construction. Since 1945 practically all such shelter construction has been concentrated in outer areas of cities. In these locations the new buildings have been of a high standard and in conformity with long-range planning schemes. These new normal shelters are well planned and wisely placed.

Technical specifications

Technical specifications for the building of the normal shelters have been set up by the Royal Board of Civil Defense. These specifications have gradually been worked out during the past twenty years by various committees with long experience in tactical, economical, and technical building problems. The sixth edition of the specifications was published in February 1961.

In general it is the problem of the Royal Board of Civil Defense to see that normal shelters are available both where people work and where they live. Thus there will be enough shelters to meet the emergency in case of a surprise attack, when there would be no opportunity to move unneeded people out of a critical area.

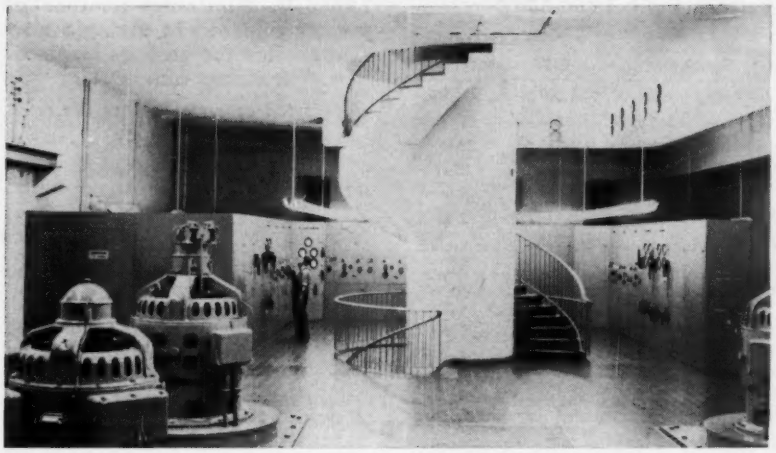
Among the requirements normal shelters must meet are:

1. Provide protection against effects from the largest bombs outside a five-mile radius from the blast site.

2. Be strong enough to resist effects from increased air pressure, or so-called over-pressure at this distance. This over-pressure has been set at one atmosphere or 14 psi, equal to 2,000 psf. Thus the normal shelter will give full protection against the

TABLE I. Normal shelters

	1945-1959	1959-1961	TOTAL	EXPECTED YEARLY INCREASE
No. of shelters	28,000	4,000	32,000	2,000
Persons sheltered	1,800,000	40,000	2,200,000	150,000
Total cost	$50,000,000	$10,000,000	$60,000,000	$5,000,000
Persons per shelter	64	100	69	75
Cost per shelter	$1,790	$2,500	$1,880	$2,500
Cost per person	$28	$25	$27	$33



Part of pump installation for Gothenburg water works, built under a mountain at Alelyckan.

Outcropping rock ridges provide economical entrances for peacetime use of shelter areas.

shock wave caused by a 20-kt atom bomb at a distance of 2,000 to 3,000 ft. For less important communes, the over-pressure has been set at only one-half atmospheric pressure, or 7 psi.

3. Be sufficiently fireproof to resist an ordinary fire for two hours.

4. Be weather-proof, that is, be water-proof and gas tight.

5. Be able to prevent infiltration of fallout.

6. Be strong enough to carry the building on top of it if this should collapse.

7. Be able to resist regular detonation bombs.

The normal shelter is a heavily reinforced concrete cubicle which constitutes a part of the reinforced concrete cellar of a building. It is equipped with machinery to supply fresh air and to protect against undesirable gases. It is also equipped to allow for long stays of the occupants, which it is anticipated could last up to two years.

A typical normal shelter designed for an apartment house with 40 five-room apartments is shown in Fig. 1. Designed to accommodate 165 persons, it consists of two medium-sized rooms, a very large room and toilets, built to fit into the cellar of the building. The entrance hall serves as a differentiator and has apparatus to catch undesirable gases.

These rooms are planned for peacetime use. Thus the aim in the construction of these shelters is to maintain the general characteristics of the building for normal use. The principal difference between this and peacetime construction is the increased strength of floors, ceilings and walls. The ceiling in a normal shelter consists of 8 in. of structural concrete; the outer walls are 8 to 10 in. thick, the inner walls 4 in., and the floors 4 to 8 in.

The design dimensions of ceilings, walls and floor of a normal shelter are determined by the requirement that a shock wave pressure of 2,000 psf must be resisted. To do this economically, removable lally columns are used, as indicated in Fig. 1. For walls below ground, the horizontal pressure to be resisted is 1,000 psf.

Openings in a normal shelter consist of doors, an emergency exit and some window openings for peacetime use. All doors in the outside walls are special units, opening out. Protection for emergency exits and for windows consists of concrete slabs 10 in. thick, kept in place by bolts of special design. Since in peacetime it is permissible to use regular windows, a good peacetime use of the normal shelter is feasible.

The risk of having exits or entrances to a normal shelter blocked after an attack has been carefully considered. The new law specifies that all exit and entrance halls shall have ceilings, walls, and floors of the same strength as that specified for the normal shelter. The hallways must be within the cellar of the building.

Since sand will clean air of fallout polution by absorption, filters utilizing graduated sand are placed outside the actual shelter but inside the building. The air is pulled into the shelter from the bottom of the 4-ft-high filter by suction fans. See Fig. 1. The air coming to the filters is pulled from the interior of the building, where there is a connection with the outside.

Used air is evacuated through overpressure valves in the entrance halls. With the help of the fans, a small overpressure is maintained in the shelter. This prevents the leaking in of

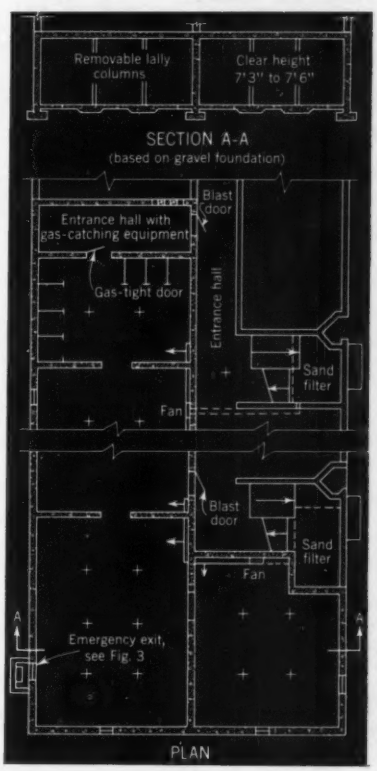


FIG. 1. Typical normal shelter, designed for 165 persons. Walls of shelter are of concrete, as built into regular cellar in a new building.

TABLE IV. Costs of normal shelters built 1954-1960

No. of Persons Designed for	Cost per Sq Meter of Floor Area				Cost per Person (0.75 m² per person)	
	Total Cellar		Shelter Only			
	2,000 psf	1,000 psf	2,000 psf	1,000 psf	2,000 psf	1,000 psf
37	$48 to 40	$43 to 40	$54 to —	$48 to 60	44 to —	39 to 60
75	36 to 40	31 to 80	40 to 60	35 to 40	32 to 60	28 to 40
100	33 to 60	29 to —	36 to 40	31 to 60	29 to 20	25 to 20
150	32 to 80	28 to 40	34 to 60	30 to —	27 to 80	24 to —
200	31 to 20	26 to 80	32 to 60	28 to —	26 to 20	22 to 40

These figures are based on prevailing prices in Sweden at an exchange rate of $1.00 equals five kronor.

Cost of cement is taken as $0.95 per bag; wages of skilled union labor-mechanics as $22 per day, or ordinary laborers, as $8 to $12 per day; salaries of engineers, at $7,000 to $8,000 per year; of draftsmen, $4,000 to $7,000 per year.

TABLE V. Maximum number of people allowed in a single normal shelter for various floors of framing above it

Reinforced concrete construction only considered

No. of Framings of Girder-Beam-Slab above Normal Shelter	Max. No. of People Allowed in Shelter
1 or 2	200
3	250
4 or 5	300
6 or more	400

undesirable gases. Overpressure can be controlled from inside the shelter.

Dimensions of sand filters are based on the fact that 1 cu yd of sand can clean 35 cu yd of air per hour, equivalent to the air volume needed for 19 persons. It has been found desirable to limit filters to about 5 cu yd of sand, good for a maximum of 100 persons.

Winter heating is provided by the existing central heating system of the building, or by electric energy. Special emphasis is put on having sufficient illumination for the easy reading of ordinary newspapers.

Changes not allowed

Although the general principle governing the building of normal shelters is to make them useful for peacetime purposes, the law states:

1. Permanent installations of equipment not needed for wartime use is not allowed. Thus oil tanks cannot be installed; and a shelter or part of it cannot be used as a kitchen, laundry, bath-house, etc., if special piping or construction is needed.

2. No additional openings for windows, doors or air-intakes can be made.

3. Columns and bearing partitions cannot be removed.

The space in a shelter allows for single beds or rubber mattresses placed side by side for two-thirds of the allotted number of people. It is assumed that the population will supply their own mattresses. It is also assumed that they will have enough food to last for two or three days, which they will bring with them or keep in assigned shelter spaces. Provisions have been made for longer stays, but the details are confidential.

The law specifies that the owner must have the following equipment for a normal shelter. Some of these articles can be stored in an easily accessible place.

Toilettes (chemical, of Swedish design, on which details are not available)—one for each group of 25 persons.
Screens for toilettes.
Medical and sickness material.
Fire-prevention tools, including (for each 50 people), a fire-axe, spade, pail, hand suction pump, and 60 ft of 2,000-lb-capacity rope.
Bulletin board.
General tools, including files, hammers, etc.

TABLE VI. Number of spaces in a normal shelter required for various types of buildings

Building	Type of Accommodation
Apartment houses:	
	Single room with housekeeping, 1.5 spaces One room and kitchen, 2.5 spaces Two rooms and kitchen, 3.5 spaces Three or four rooms and kitchen, 4.0 spaces Five rooms and kitchen, 4.5 spaces Six or more rooms and kitchen, 5.0 spaces
Educational insts.	For 60 percent of all occupants
Hospitals	2 spaces for each sick bed
Industrial plants	One space for every person employed in one shift
Offices	One space for each 21 sq ft of floor area
Stores	2 spaces for each person employed
RR and bus stas.	One space for every person permanently employed plus ½ space for each normal passenger
Theaters, restaurants, halls	Visitors need not be considered
Other buildings	One space for each person normally present

TABLE VII. Emergency loadings that normal shelters must resist

Surcharge Designed for	Direct Load	Uplift
½ atmosphere	512 psf	—82 psf
1 atmosphere	1,024 psf	—164 psf

The cost of a normal shelter

A survey of about 10,000 normal shelters of various sizes indicates that the average cost of a 100-person shelter is $30 per person if designed for 2,000 psf, and $25 per person if designed for 1,000 psf. These costs constitute the difference between the total cost of the normal shelter with equipment, and the cost of the same space used as a regular cellar. Thus, the total cost of a normal shelter with all needed equipment represents about 2 percent of the total cost of the building. The cost chart, Table IV, is based on experience obtained from about 10,000 normal shelters.

Size of normal shelters

The minimum net area provided per person is 8.1 sq ft. This is exclusive of entrance halls, toilettes, and space needed for supplies, including water cisterns. The area of the entrance hall with "gas-catcher" for each group of 50 persons is a minimum of 32 sq ft. For supplies, an area of 21 sq ft is allotted for each group of 100 persons. Table V gives the number of people allowed in a single normal shelter, and Table VI, the number of shelter spaces required for various types of buildings.

Every room in a normal shelter must have openings in at least two directions. A door with the normal width of 33 in. is used for each group of 200 persons. Each room must have an additional exit in an exterior wall at the greatest practical distance from the main entrance, if possible on the opposite side of the building.

The door to the entrance hall (Figs. 1 and 2) is a so-called "protection door." Between the entrance hall and the actual shelter a "gas-tight door" is used.

Method of design

To make the design of a normal shelter as economical as possible, a flat-slab system with movable columns is used in framing the shelter roof. Thus the ceiling construction is designed to meet both a peacetime load of 100 psf, and an emergency load of 2,048 psf. To enable the ceiling to carry the emergency loading temporarily, the spans are reduced to ⅓ or ¼ of the original spans by the use of movable lally columns. In Fig. 1 crosses indicate the locations of these movable columns.

Emergency loadings that normal shelters must resist are given in Table

VII. Thus the ceiling of a normal shelter is designed for the "emergency loading" plus one-half of the dead load. To avoid the provision for uplift, the ceiling must weigh at least 164 psf when designed for a surcharge of ½ atmosphere, or 328 psf when designed for 1 atmosphere.

All outside walls above ground level must be designed for "direct emergency loading" acting horizontally in either direction. For outside walls below ground level, the horizontal loading will be one-half of the "direct emergency loading" as given in Table VII. The earth pressure does not have to be included in these horizontal forces. However, walls designed without "emergency loading" must be designed for the earth pressure.

The floor slab in the normal shelter has to be designed to meet various conditions. If the slab is poured on good ground, no special arrangements are required. However, if the foundation material is clay or some other material with poor bearing qualities, the floor has to be designed as an inverted slab system. It will then generally have the same construction as the ceiling.

Details of emergency exits are given in Fig. 3. About 1,800 normal shelters have the type of emergency exit shown in (*a*), and about 15,000 the type shown in (*b*). Type (*c*), with a tunnel, is recommended for tall buildings. This is a late recommendation; so far only about 900 normal shelters have this type of emergency exit.

Rock shelters

The rock shelters are supposed to give protection against the effects of such weapons as may be used in an all-out attack. These shelters also protect against effects other than those produced at the site of the blast. For protection against shock waves, they are designed to resist a minimum of 20,000 psf or, in the case of certain important shelters, to resist at least 40,000 psf. Thus these shelters will be safe against a 1-megaton (MT) bomb at a distance of 3,300 ft from the site of the blast.

Rock shelters can be built either as a so-called "rock room" or as a so-called "concrete room"—free-standing or in combination with a building. Three types are now being built:

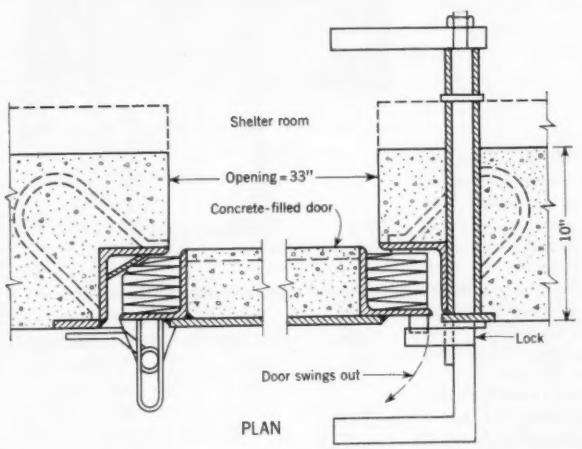
1. Those to house Civil Defense personnel only, of which there are a total of 79 to date. See Figs. 4 and 5 and Table II.

2. Those to house large groups of the population, of which 15 have been built. See Tables III and VIII and Fig. 7.

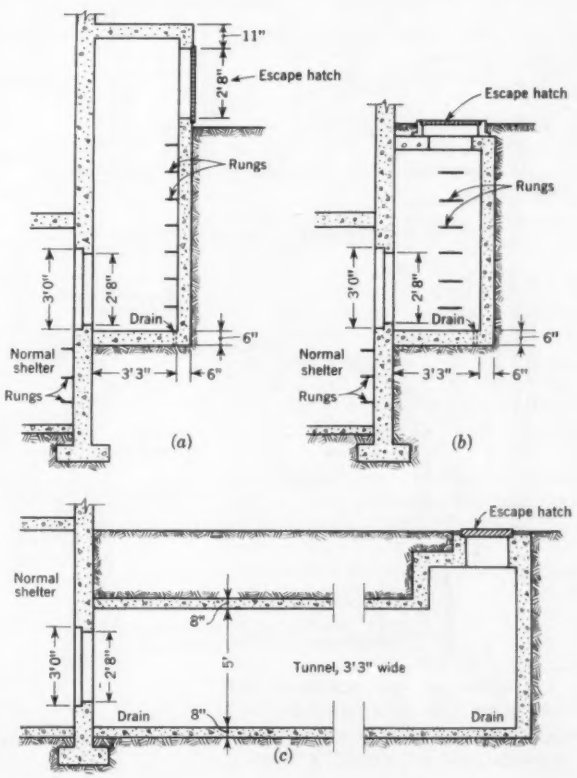
3. Military shelters.

The rock room has exterior protection consisting of the undisturbed rock itself, to a minimum depth of 50 ft. The entrances are long tunnels, on a slope of not more than 1:50, and pro-

Drills held by mechanical arms cut holes for light charges of blasting explosives.



▲ **FIG. 2. Typical door with shock-absorbing frame for a normal shelter, in plan.**



▶ **FIG. 3. Typical reserve exits for normal shelters, in vertical cross-section: (*a*) with a vertical opening, (*b*) with a horizontal opening, (*c*) with a tunnel, a late recommendation for tall buildings.**

TABLE VIII. Mass rock shelters built in Sweden

Place	Rock Excavation, cu yd	No. of Persons	Peacetime Use	Total Cost	Finished	Volume, cu yd		Building Time, Years
						Total	Shelter	
Stockholm	65,000	10,000	Garage, 300 cars	$1,820,000	May 1955	45,500	22,100	3.0
Stockholm	130,000	20,000	Garage, 600 cars	$4,000,000	Dec. 1955	121,000	52,000	4.0
Stockholm	41,600	7,000	Garage, 500 cars	$1,660,000	Jan. 1956	32,500	15,600	2.5
Stockholm	65,000	15,000	Garage, 360 cars + 50 mot. cycles	$4,000,000	Mar. 1958	41,600	27,300	3.5
Gothenburg	58,500	12,500	Garage, 224 cars	$2,250,000	Jan. 1957	44,300	27,300	3.5
Gothenburg	28,600	5,000	Warehouse	$1,000,000	Mar. 1956	16,600	8,600	2.5
Malmoe*	0	4,240	Meeting halls	$423,000	Oct. 1955	16,700	10,700	1.0
Malmoe*	0	3,200	Warehouse	$500,000	Feb. 1957	16,100	7,300	2.0
Norrkoping*	0	2,685	Garage, 120 cars	$480,000	Jan. 1956	17,600	6,900	1.5
Halsingborg	18,300	3,000	Garage, 100 cars	$560,000	Projected but not yet started			
Orebro*	0	4,980	Warehouse	$620,000	Feb. 1956	19,600	10,400	2.0
Vasteras	45,500	5,500	Youth center	$1,500,000	Jun. 1956	34,000	26,000	4.0
Boras	8,100	2,300	Garage, 500 cars	$500,000	May 1956	7,950	6,500	1.0
Karlskrona	24,500	5,000	Sports arena	$800,000	Dec. 1956	24,300	17,100	2.0
Katrineholm	7,300	1,200	Workshops	$180,000	Jan. 1954	5,710	3,880	3.0
Totals	492,400	101,605	2,845 cars plus 50 motorcycles	$20,293,000		464,460	241,680	

*A reinforced concrete shelter built above ground inside a larger building.

vided with several shock-wave pockets. See Fig. 4. Between the entrance tunnel and the actual shelter there are entrance halls with pressure doors. See Figs. 4, 5, and 6. These entrance halls have two compartments—the outer is a so-called "pressure room," where the effects of a shock wave can be eliminated, and the inner is a so-called "gas room," where undesirable gases can be disposed of.

The entrance hall in the typical rock shelter for defense personnel (Fig. 4) is supplied with a 20-ft-deep dead-end tunnel to act as a secondary shock-wave pocket. But ahead of this several shock-wave pockets are built in near the entrance to the tunnel. These are located just ahead of the main 20-ton concrete door, designed to take a shock wave of 200,000 psf.

To protect the entrances of air-intake ducts and other openings from shock waves, very exacting specifications are followed. In the case of air-intake ducts, the air goes first through a quick-acting valve, then through a stone filter, then through a filter to eliminate fallout particles of the second grade and finally through a filter

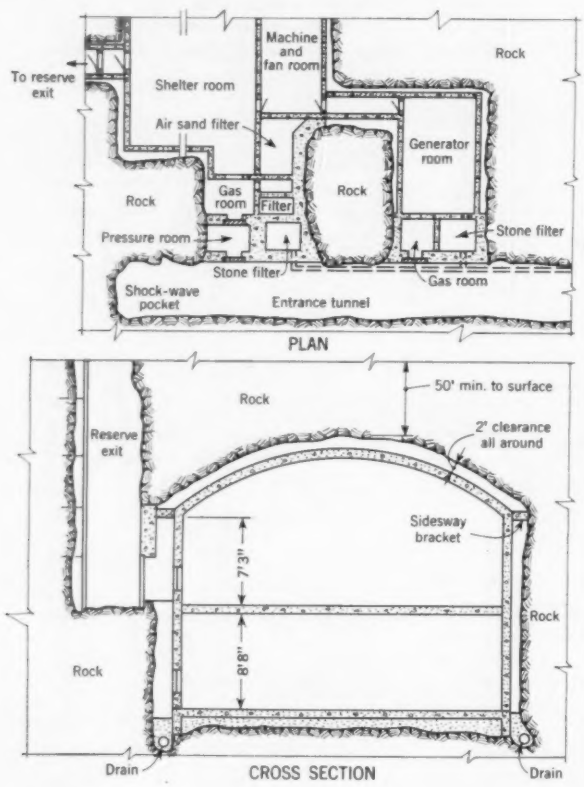


FIG. 5. Entrance tunnel for rock shelter with special shock-wave absorbers. So far 22 rock shelters have been built with this type of entrance.

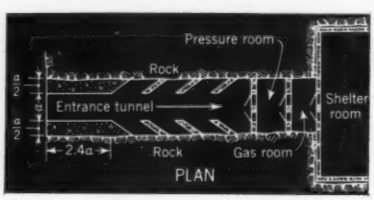


FIG. 4. Typical plan of rock shelter for civil defense personnel, with minimum rock cover of 50 ft. (Cover often exceeds 100 ft.) Cross section through shelter room shows emergency exit. Bottom floor, from the top down, consists of 5 in. of reinforced concrete, building paper, 2.5 in. of lightweight concrete, 2 in. of fine stone, and 4 in. of gravel. Reserve exit includes observation post, at surface, and requires one or two horizontal offsets.

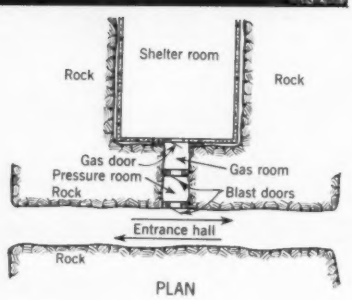
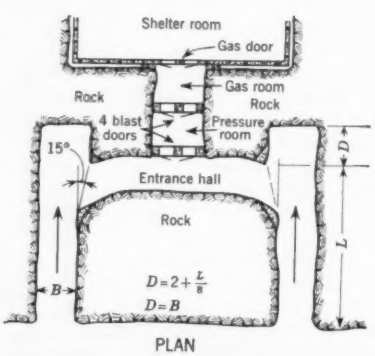
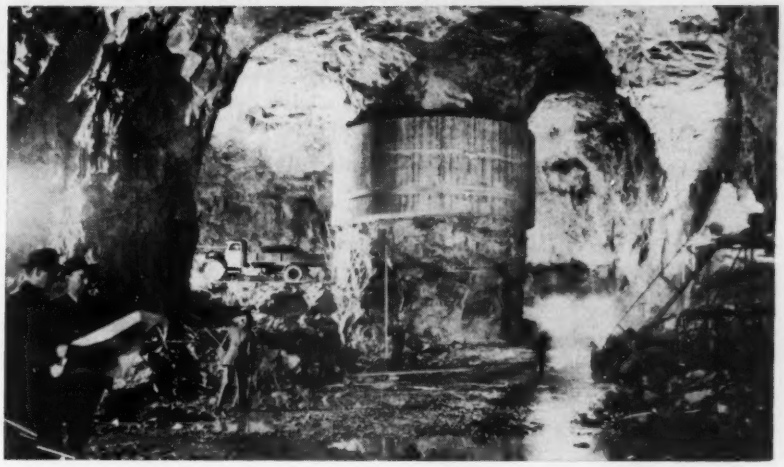


FIG. 6. Two types of entrance hall through rock. Upper type has been built for 12 rock shelters, lower type, with double entrance hall, for 26.



to remove carbon and other impurities. The quick-acting valve automatically shuts off the air intake at the approach of a shock wave in a very short period of time, estimated at a few micro-seconds. This is a direct protection against the entrance of a shock wave into the shelter.

The reaction from regular bombs is different from that from an atomic bomb in that it lasts a much shorter time but has a shock wave of higher pressure. The stone filter, which is designed to neutralize these shock-wave pulses, has a 4-ft-thick layer of fist-sized round stones. This filter is energy absorbing and also acts as an expansion chamber for the quick-acting valves. Glass filters are also available to take care of fallout, radioactive particles, and other small particles that may be in the incoming air.



Excavation for a deep underground shelter. Column supports dome of central area, from which rooms radiate.

Mass rock shelters

Construction of the so-called "mass rock shelters" was started in 1951. Since these shelters are built where the risk of extensive fires is great, they are equipped so that they can be closed hermetically for at least ten hours. During this time the by-product carbon is absorbed in special lime filters built into the ventilating system, while the needed oxygen is supplied from oxygen tanks. It is required that during catastrophes each person will have 53 cu ft of air per hour. In normal times the system provides 200 to 300 cu ft per person per hour.

In the mass rock shelters, the shelter rooms as well as the entrance halls and tunnels are free-standing concrete structures built into the rock cavities that have been blasted out, as can be seen in Fig. 4. These structures must be designed to resist to some degree the effects of shock waves that may bypass some of the shut-off valves. The roofs of all shelter buildings are strong reinforced-concrete arches, capable of carrying safely smaller amounts of rock that may be loosened by an atomic blast in the vicinity.

Technical equipment in mass rock shelters consists of:

1. Filters of various kinds for the treatment of air.
2. Air-conditioning machinery for cooling and heating. It has been found that, even in winter, cooling is needed in rooms with running machinery, where many persons are congregated. For a shelter loaded to capacity, it is estimated that half the created heat-energy must be eliminated. Cooling is accomplished by ice-machines and large basins filled with water and ice. The heating equipment is installed for peacetime use only, and even then it is hardly needed. A new, fully automatic, heat-pump system is used.
3. An independent water system. All rock shelters have deep wells capable of supplying all the needed water.
4. Sewage and garbage removal. Pressure pumps will deliver sewage and garbage in designated locations.
5. A reserve power supply. In case the central power system is paralyzed, the reserve power-generators start automatically. The oil supply will keep the generators going for at least 12 months.
6. Communication systems, internal and external.
7. Radio and television.

FIG. 7. Mass rock shelter at Karskrona, in star shape.

8. Indicators that show such conditions as radioactivity, gamma rays, air pressure, and carbon content of the air.

An example of a mass rock shelter, called *Konstapeln,* is given in Fig. 7. It is located in the town of Karlskrona, 220 miles south of Stockholm. It is a two-story shelter with 50 ft of rock above it. The total usable floor area is 33,000 sq ft. It can take a maximum of 5,000 persons sitting for a short period, or 1,300 for a long period. It is now in use as a sports arena. This shelter was started in February 1955 and finished in December 1956, at a total cost of $800,000. Excavation involved 24,500 cu yd of rock at $8.20 per cu yd.

Table VIII summarizes data on all the mass rock shelters so far built in Sweden. It should be noted that all these shelters are now in peacetime use as garages, warehouses, meeting halls, gymnasiums, sports arenas, work shops, or other facilities.

The writer is greatly indebted to the Hon. Ake Sundelin, Minister, Royal Board of Defense, and to Brig. Gen. Erik Lidstrom, Director, Swedish Fortifications; also to the Hon. Hans Hollander, Acting Minister, Royal Board of Civil Defense, who personally guided him through several of the more famous rock shelters in various parts of Sweden, and to Dr. Sten Bergman, Chief, Research Department, Swedish Fortifications.

He is also indebted to Civil Engineer Fritz Gosta Smitt, Director of the Technical Bureau, Royal Board of Civil Defense; to Civil Engineer Gunnar Friberg, Assistant Director of the Technical Bureau, Royal Board of Civil Defense; and also to Architect John Eliason, the planner and creator of many of the larger rock shelters.

THE READERS WRITE

Value of earth fills or "prefabricated foundations"

TO THE EDITOR: The concepts described in the article, "Compacted Earth Fill for a Power-Plant Foundation," by Messrs. Smoots and Benton in the August 1961 issue, represent a very important advance in the science of geotechnics or soil mechanics.

Many times I have heard some engineer say, "we can put it [a structure, canal, or pavement] entirely on cut and avoid trouble." This archaic opinion originated in the days of uncontrolled, uncompacted fills, before the development of geotechnics. This naive assumption still prevails in practice, reflecting the lack of understanding of the value of soil mechanics. In assuming that a cut surface is ideal for a foundation, the engineer is taking a lot for granted. He would be assuming a uniformity of materials, a uniformity of physical properties, and a consistency of properties with time. All these conditions very seldom exist in nature.

When he uses a compacted fill, the engineer knows exactly what materials, with known properties, go into the fill and they will have a reasonable uniformity—assuming he has the foresight to make a foundation investigation and uses proper construction controls. In effect, the engineered fill is a "prefabricated foundation" that can be a great improvement in quality over nature. The advantages realized can be a big reduction in the risk of failure in the use of a site, an expanded selection of sites, and the economies of foundation design the authors mention.

The method of performing the relative compaction tests in the Coronado fine sand was interesting and worthy of some note. Since the standard field density test was impossible, an alternate was selected but the authors did not mention whether the membrane or oil volume methods were considered instead of the tube of rings. Tube sampling might have been the only possible test method since it could be performed under water.

The use of the tube is the most convenient way of obtaining the sample, but in my experience I have found that tube sampling requires considerable caution. Before it is accepted for general use on a project, I would recommend thorough checks with proven methods. Tube sampling frequently has created a disturbance in the specimen depending upon the tube geometry, material sampled, and relative density of the material. A beveled cutting edge was required to prevent "packing" the tube and obtaining high densities. Disturbance in SW, SP, and some SM (unified classification system notation) would tend to give low densities and, occasionally, to give recovery ratios greater than one. Disturbance appeared to vary directly as some power of the relative density of the material. The solution to suppressing the disturbance appeared to be a properly beveled cutting edge. The authors' tube sampler evidently is a success since they could obtain satisfactory results on what apparently was SP material.

"Prefabricated foundations" are economical and feasible as Messrs. Smoots and Benton have demonstrated, if the science of geotechnics and proper construction procedures are used. The benefits from "engineered fills" should be given consideration wherever possible in project planning.

EDWARD A. FOSTER
Civil Engineer

Chowchilla, Calif.

Graph solves deflection on a continuous beam

TO THE EDITOR: In his article in the September issue, "Deflection Calculated by the Conjugate-Beam Method," Mr. Mann presents three useful graphs to facilitate calculating the deflection at any point on a continuous prismatic beam. Unfortunately, he beclouds the subject by a discussion of the conjugate-beam method, thereby conveying the false impression that construction of these graphs requires the application of this method exclusively.

After the bending moments at the supports of a continuous beam have been determined, each span can be isolated from the rest of the structure and treated as a simple span carrying the given vertical loads and subjected to external moments at the supports. The deflection at a given point is then obtained by calculating the deflection caused by the vertical loads and by the end moments and, in accordance with the principle of superposition, totaling the results. The manner in which the formulas for the individual deflections have been derived is immaterial.

Mr. Mann's graph for k_s applies to a prismatic beam carrying a uniform load. Graphs that apply to other situations can be constructed. Assume, for example, that a simply supported prismatic beam carries a distributed load that varies uniformly in intensity from zero at the left end to w kips per lin ft at the right end, Fig. 1. The deflection at a given point is

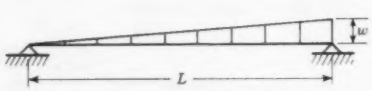


FIG. 1. Triangular load on a simple span.

$$\Delta_s = k_t\,(wL^4/EI)$$

where

Δ_s = deflection at a given point, in in.
w = unit load, in kips per lin ft
L = span, in ft
E = modulus of elasticity, in kips per sq in.
I = moment of inertia, in in.^{4}
k_t = coefficient from Fig. 2

Example. A simply supported beam on a span of 30 ft carries a load that varies uniformly from zero at the left end to 2.5 kips per lin ft at the right end. Compute the deflection at a point 18 ft from the left end. Use $E = 29 \times 10^3$ kips per sq in., and $I = 800$ in.^{4}

Solution. From Fig. 2, obtain $k_t = 10.9$ when $x/L = 0.6$. Then

$$\Delta_s = \frac{10.9 \times 2.5 \times (30)^4}{29 \times (10)^3 \times 800} = 0.951 \text{ in.}$$

A trapezoidal load can be resolved into a uniform and a triangular load. Therefore if the given span of a continuous beam carries a trapezoidal load, the deflection at any point can be determined by applying the coefficients k_s and k_b to the end moments, the coefficient k_s to the uniform load, and the coefficient k_t to the triangular load. The first three coefficients are obtained from Mr. Mann's graphs and the last from the accompanying Fig. 2.

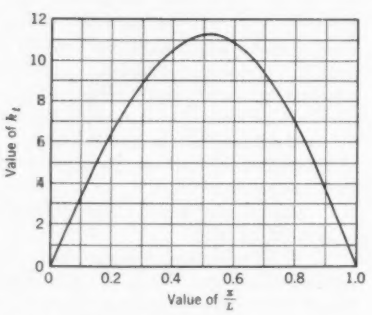


FIG. 2. Graph for values of k_t.

MAX KURTZ
Consulting Engineer

Brooklyn, N. Y.

Concreting plants at large dams compared

To the Editor: In connection with Mr. Peraino's valuable article, "Concreting Techniques at Glen Canyon Dam" (July issue, p. 50), it is interesting to note that, while the concrete plant is large, its bin capacity of 3,000 tons and its production capacity of 480 cu yd per hr are considerably below those of the plant used at Grand Coulee Dam.

On May 25, 1939, the plant at Grand Coulee Dam produced 20,684 cu yd in one day. The average hourly rate was 861 cu yd and the peak, 912 cu yd, more than 1 cu yd every 4 seconds. This same plant produced over 18,000 cu yd per day for a one-month period. The Grand Coulee Plant had an unusual siamese-twin arrangement of two 1,350-cu yd bins to supply eight 4-cu yd mixers. Total bin capacity was about 4,000 tons. For placement, 4-cu yd buckets were used.

It may also be of interest that the plant used on Shasta Dam stored about 4,400 tons of material over its five 4-cu yd mixers.

John S. Shapland, F. ASCE
Chief Engineer
The C. S. Johnson Company

Champaign, Ill.

A tribute to Roy W. Crum from a former student

To the Editor: Congratulations on the reprinting, in the September issue (p. 46) of the well-written words of Roy W. Crum on how to prepare and present a paper.

I still recall his classroom lectures on materials of construction at Iowa State College nearly 45 years ago, and how well his presentation of the subject matter exemplified the message of his reprinted essay. Thanks from one of his students of years ago.

Earnest Boyce, F. ASCE
Prof., Sanitary Eng., and Chairman, Dept. of Civil Eng.
Univ. of Michigan

Ann Arbor, Mich.

To find the radius of a curve

To the Editor: In these days of miraculous electronic computers it may seem reactionary to be concerned with short-cut methods for manual computation of the radius of a curve from the length of an arc and its subtended chord, but the comments of Messrs. Hickerson and Goldberg (August issue, p. 67), on Mr. Kagan's technique (May issue, p. 70), deserve both commendation and explanation.

Mr. Goldberg used three terms of a sine series to derive a biquadratic which is easily solved. Had he used only two terms, he would have found,

$$r_2^2 = \frac{b^3}{6\,(b-a)} \quad \ldots\ldots\ldots (1)$$

which is very precise for small central angles. Then his quadratic would yield the relation,

$$r_3^2 = \frac{r_2^2}{10}\left(5 + \sqrt{30\,\frac{a}{b} - 5}\right) \quad \ldots\ldots (2)$$

to be used for larger angles. As the angle increases, a fourth term would be needed, leading to a bicubic equation to be solved by Horner's method. For the example, $a = 7.76$, $b = 7.85$ for which Mr. Kagan's technique found $r = 30$, and Mr. Goldberg found $r = 29.9$. The several series solutions give,

$r_2 = 29.93006$
$r_3 = 29.87837$
$r_4 = 29.87848$

Professor Hickerson's equation was derived for a 100-ft arc. For this special case it would be simpler to use Eq. 1 above with $b = 50$, excess $= 2(b - a)$, so that

$$r_{100} = \frac{204.124}{\sqrt{\text{excess}}} \quad \ldots\ldots\ldots (3)$$

R. Robinson Rowe, F. ASCE

Naubinway, Mich.

* * * *

To the Editor: My discussion of Mr. Kagan's article, "To Find the Radius of a Curve," in the August issue, p. 67, is incomplete in that it refers only to arcs of 100 ft. For shorter arcs, the "excess" varies as the cube of the central angle, with correspondingly greater accuracy. Thus

$$2\,(b-a) = \left(\frac{2b}{100}\right)^3 \left[0.127\left(\frac{D}{10}\right)^2\right];$$

from which

$$D = \frac{(100)^2\sqrt{2(b-a)}}{\sqrt{1.016\,b^3}} = 191.374 \text{ deg.}$$

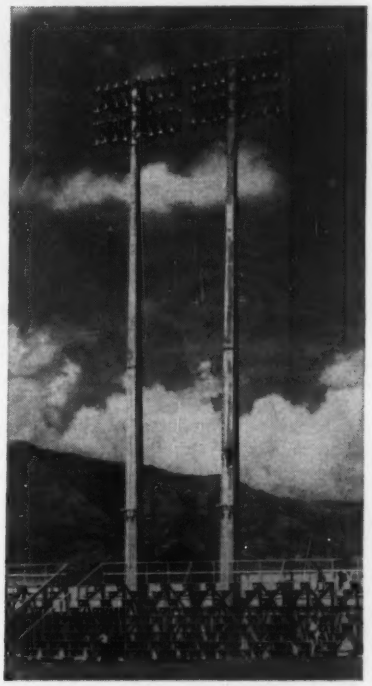
Then $r = \dfrac{5{,}729.578}{191.374} = 29.94$ ft

T. F. Hickerson, F. ASCE
Formerly, Prof. of Civil Eng.
Univ. of North Carolina

Chapel Hill, N.C.

Costa Rica has tallest precast concrete towers

To the Editor: I read with interest the article by Messrs. Schupack and McDonald, "Experimental Transmission Tower of Prestressed Concrete," in your August issue. The article states that "This structure is believed to be the largest precast concrete tower constructed to date." To set the record straight I would like to point out that it may be the heaviest but it certainly is not the tallest.



View of two of the precast, prestressed concrete towers in San Jose's Baseball Stadium.

In February 1961, Productos de Concreto S.A. of San José, Costa Rica, designed, fabricated and installed ten pretensioned precast towers for the illumination of San José's Baseball Stadium. Each tower is 30.50 m (100.04 ft) long above the ground and 1.40 m (4.59 ft) underground, totaling 31.90 m (104.63 ft) in length; 0.85 m (33.46 in.) across at the base and 0.30 m (12 in.) at the top; and weighs 19 tons. For the pretensioning, Dr. Fritz Leonhardt's Leoba method and cables were employed. Design and calculations were done by Franz Sauter, A.M. ASCE, manager of Productos de Concreto.

It makes me happy to know that, small as our country is, it has the highest precast towers in the world. Even if this record should last only for a very short time, which is very likely since prestressing and post-tensioning have unlimited possibilities, I believe the fact is worth mentioning.

Guillermo A. Arguedas, M.ASCE
Empresa Constructora Arguedas Ltda.

San José, Costa Rica

ASCE NEWS

Board of Direction Meets in New York

The ASCE Board of Direction met in New York on October 16 and 17, during the Annual Convention of the Society. Retiring President Glenn W. Holcomb was in the chair, and incoming President G. Brooks Earnest was present by invitation of the Board, as were the newly elected Vice Presidents and Directors

The outstanding Board action was approval of a new type of ASCE Convention program, developed by Executive Secretary W. H. Wisely. Actions of special interest are briefed here.

New concept of ASCE technical programs

The Board approved in principle **"A New Concept of Technical Programs in ASCE,"** essentially as described in the September issue of CIVIL ENGINEERING, with the intent that the Committee on Division Activities shall give the broadest possible interpretation to the terms, "Water Resources," "Transportation," "Environmental Engineering," and "Structural Engineering" — the four major areas of civil engineering practice suggested for overall Convention themes.

In the implementation of the "New Concept for Technical Programs in ASCE," the Conditions of Practice area of interest is not to be neglected at any basic conference.

It was further urged that consideration be given to the inclusion of technical session programs, already partially or completely arranged in accordance with previous Convention practice, in the hope that all Divisions will make every effort to adjust their programs to the new schedule with its rotation of subjects.

ASCE Research Prizes

The Board voted to confer the **1962 Research Prizes** upon the following ASCE members: Harry Bolton Seed, of the University of California; William H. Munse and Anestis S. Veletsos, of the University of Illinois; Emmett M. Laursen, of Michigan State University; and Stanley D. Wilson, partner in the consulting firm of Shannon and Wilson, Seattle, Wash. Biographies of the recipients will appear in a later issue.

It was also voted to amend the rules governing the Research Prizes by adding to Section I the words, "Preference shall be given to **younger men** of early accomplishment, who can be expected to continue fruitful careers in research."

Construction Engineering Prize is renamed

Approval was given to changing the name of the Construction Engineering Prize to the **A. P. Greensfelder Prize,** in honor of the donor, the late A. P. Greensfelder, Hon. M. ASCE.

Registration fee rules changed

Changes in Convention **registration fees** will be possible as a result of the Board's vote to amend the Rules of Policy and Procedure by deletion of the sentence, "The registration fee shall not exceed $5.00, with women and students exempt from this fee."

Reimbursement for travel

It was voted that "administrative committees technical" that are supervising the work of several task committees within a Division be considered control groups in their entirety, for the purpose of authorizing **reimbursement of travel costs** for such administrative committees.

Authorization was given to changing any rules necessary to permit travel reimbursement to **Division committee chairmen** for attendance at Division executive committee meetings, at the invitation of the chairman of the committee. Authorization was also given for a **Technical Division vice chairman** to attend meetings of the Technical Procedure Committee, as alternate to the chairman, whenever the Division chairman cannot attend.

New sources of income

The Board endorsed appointment of a task committee charged with exploring possible **new sources of revenue** for the Society.

Technical Division changes

The Board voted to amend the name of the Air Transport Division to the **Aero-Space Transport Division,** and to amend its purpose to:"(*a*) the advancement of the science of civil engineering as related to the administration, economics, planning, design, construction, operation and maintenance of civil and military aero-space facilities; (*b*) the professional improvement of civil engineers interested in aero-space transport and related work."

It was also voted to approve the establishment of a **Water Quality Research Council** within the **Sanitary Engineering Division.**

The stated purpose of the **City Planning Division** was amended. Its enlarged scope will be reported in a later issue.

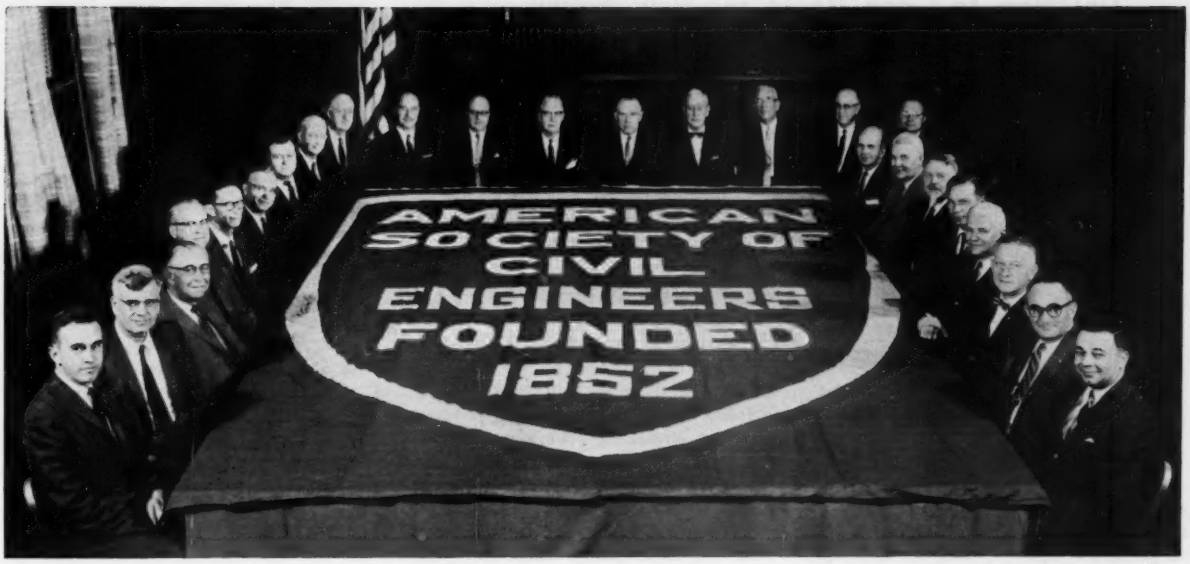
Membership qualification

The Board confirmed action taken by the **Committee on Membership Qualification** on 35 cases considered on October 15. Applications from nine candidates were declined.

Authorization was given to the Committee on Membership Qualification to pursue its study of a proposal to admit to membership persons with scientific training and attainment, and to develop recommendations for implementation of this proposal.

Membership Directory authorized

The Board voted that provision be made in the 1962 budget for publication of the **biennial Membership Di-**



New ASCE Board of Direction meets during Convention week. Reading counterclockwise around the table, members are Leland J. Walker, Director, District 12; N. A. Christensen, Director, District 3; Roy M. Green, Director, District 16; C. Merrill Barber, Director, District 9; John D. Watson, Director, District 10; Henry W. Buck, Director, District 2; Woodrow W. Baker, Director, District 14; Thomas M. Niles, Director, District 8; E. L. Chandler, Treasurer; William H. Wisely, Executive Secretary; Donald H. Mattern, Vice President, Zone II; G. Brooks Earnest, incoming President; Burton G. Dwyre, Vice President, Zone IV; Carey H. Brown, Vice President, Zone I; Frank A. Marston, Past President; Glenn W. Holcomb, outgoing President; Trent R. Dames, Director, District 11; Charles W. Yoder, Director, District 7; Samuel S. Baxter, Director, District 4; Waldo E. Smith, Director, District 5; Harmer E. Davis, Director, District 11; David G. Baillie, Jr., Director, District 1; Henderson E. McGee, Director, District 11; Bernhard Dornblatt, Director, District 15; and Roger Gilman, Director, District 1.

rectory. A charge—to be determined by the Committee on Publications—will be made to cover as much of the cost as is feasible.

It was also voted to approve **ASCE participation**—jointly with the American Public Health Association, the American Water Works Association, and the Water Pollution Control Federation—in updating the publication, **"Glossary—Water and Sewage Control Engineering,"** published in 1949.

Practice of land surveying

Acting on recommendation of the Conditions of Practice executive committee, the Board voted that the Society urge each state registration board to develop progressively and as rapidly as circumstances will permit, its requirements for the **practice of land surveying** so that the status of the practitioner in the field shall be comparable to that of professional engineers practicing in other fields. This action will be discussed more fully in the December issue.

National Water Policy

The Board authorized that all recommendations dealing with **water policy,** originating in the Society, be referred to the National Water Policy Committee before the Society establishes any position on it.

Conventions

On the recommendation of the Committee on Convention Policy and Practice, the Board voted that the **San Francisco Structural Conference,** in October 1963, be recessed at the close of the program on Friday and reconvened in Hawaii for a continuation of the Structural Engineering theme. This action was taken in response to the invitation of the Hawaii Section. The Society will assist with publicity but will not assume responsibility for any other arrangements.

The Board voted to hold a **basic conference at Miami Beach** in February 1966 in response to the invitation of the South Florida Section, subject to satisfactory arrangements for headquarters hotel and dates.

United Engineering Center

In consideration of the successful completion of the **United Engineering Center** project by the United Engineering Trustees, Inc., the Board passed a resolution in behalf of its more than 47,000 members, recording "its gratitude and appreciation to United Engineering Trustees, Inc., and to Shreve, Lamb and Harmon, architects; Seelye, Stevenson, Value and Knecht, consulting engineers; and to the Turner Construction Company, general contractors, for their highly successful collaboration in the execution of the United Engineering Center project. The completed building reflects great credit on all who took part in its planning, financing, design, and construction. The Center stands as a living example of engineering unity, and is a source of intense pride to the Societies and other engineering agencies that are privileged to call it their home."

Convention acknowledgments

In appreciation of the outstanding success of the Convention, the Board directed the Executive Secretary to send appropriate letters of thanks to all individuals and organizations that took part in its planning and conduct.

UET Host to Open House for New Neighbors

A luncheon on September 28, with United Engineering Trustees as host, was the first official function in the new United Engineering Center. The luncheon—officially a kind of housewarming to greet our professional neighbors in the United Nations area—also featured the opening of the metal box put into the cornerstone of the old Engineering Societies Building (on 39th Street) on May 8, 1906, by the late Mrs. Andrew Carnegie.

UET President Willis Thompson welcomed representatives of the United Nations, the U.S. Mission to the United Nations, the Carnegie Endowment for International Peace, the Boys' Clubs of America, the IBM World Trade Corporation, the American Institute of Physics, and the Society of Automotive Engineers—all neighbors of the engineering societies in their new headquarters.

Mr. Thompson told the group, "I am sure that all of us, in the engineering profession, feel proud to be included in what has become known as the United Nations complex of buildings. As we look out of our windows at the magnificent United Nations building, we cannot help but feel that we are where we belong. The reason is that American engineering skills are now spanning the world, and largely in the interests of peace, which is what the United Nations stands for. It is the considered opinion of most of us that American engineering talent will be required more and more in behalf of international peace, as we progress through the difficult times that lie ahead. We stand ready to make such contributions, and we are now close enough to go across the street to help, when our help is needed."

In introducing Joseph E. Johnson, president of the Carnegie Endowment, Mr. Thompson said that with the "Carnegie Endowment for International Peace just across 47th Street, I have the feeling that this association is predestined coincidence. The man who was responsible for the first unification of the engineering profession, Andrew Carnegie, in making possible the first engineering building, also is the man who devoted his life, and funds, to peace. And now two of the results of his many benefactions are next-door neighbors."

In presiding at the opening of the cornerstone box from the old Engineering Societies Building, Mr. Thompson introduced Frances Selig, a long-time employee of the American Society of Mechanical Engineers, who was present when the box was placed in the cornerstone over 55 years ago. The box contained copies of the papers of the day, issues of *The Scientific American,* a collection of gold coins, and a medallion bearing Andrew Carnegie's brief and generous message to the profession, written on March 14, 1904: "It will give me great pleasure to devote, say, one and half million dollars for the construction of a suitable home for you all in New York."

Viewing the box taken from the cornerstone of the old Engineering Societies Building are: UET President Willis Thompson (left); Frances Selig, veteran ASME employee, who was present at the placing of the box 55 years ago; and Joseph E. Johnson, president of the Carnegie Endowment for International Peace.

EMC Sponsors Program For Conserving Manpower

A new program designed to safeguard the effective utilization of engineering and scientific manpower in the event of a national emergency has been announced jointly by Dr. Sydney B. Ingram, chairman of the Engineering Manpower Commission of Engineers Joint Council, and Col. Daniel O. Omer, Deputy Director of Selective Service. The new program, called Employer's Inventory of Critical Manpower, is endorsed and supported by the Director of Selective Service.

The Inventory program will supply condensed information on critical employees' liability to the draft and show what will happen to a given company during mobilization. It will identify the balance between critical and noncritical personnel, subject to military service, and indicate the probable order of call to the armed services during emergency. It will also provide both employers and Selective Service with a complete analysis of critical personnel problems through the collection and tabulation of relevant Selective Service data.

According to Dr. Ingram, "present safeguards are inadequate to prevent the wholesale withdrawal of engineering and scientific manpower from industry in a national emergency. The increasing importance of technological manpower in the event of armed conflict," he said, "demands maximum utilization of engineering and scientific personnel whether in industry or the armed services. We view with deepest concern present inadequate provision to prevent wholesale disruption of essential production and the slowing down of the rate of technological advance in the event of a sudden and substantial mobilization. The Employer's Inventory . . . is an attempt to aid in the solution of this problem in the national interest."

Industry is urged to take advantage of this cooperative program to strengthen national security. EMC will supply the necessary forms.

Errata Sheet for ASCE Nuclear Blast Manual

Members who have purchased ASCE Manual No. 42, "Design of Structures to Resist Nuclear Weapons Effects" (July issue, page 67), will want to have the Errata Sheet that is now available. Copies of the listing will be sent to all purchasers, upon request to Society headquarters.

Chemical Engineer Wins John Fritz Medal

Crawford H. Greenewalt, president of E. I. du Pont de Nemours & Company, will be the 1962 recipient of the John Fritz Medal, which has been called the highest honor in the engineering profession. Established in 1902, as a memorial to the great engineer and steelmaker whose name it bears, the medal has been presented to some of the world's most distinguished engineers and scientists.

Mr. Greenewalt is cited "For outstanding contributions . . . through leadership in research, in the translation of research achievements by way of sound engineering into useful products," and through his "able championship of the American free-enterprise system both in the spoken and written word."

Presented not more than once in any year for scientific or industrial achievement in any field of pure or applied science, the John Fritz Medal is sponsored jointly by the five Founder Socieites. The United Engineering Trustees, Inc. is custodian of the award.

Mr. Greenewalt has been president, chairman of the Executive Committee, and a member of the Finance Committee of E. I. du Pont de Nemours & Company since January 1948—the peak in a career begun in 1922 when he joined the Philadelphia Works of the company as a chemist. Before assuming the presidency, Mr. Greenewalt had been stationed in four manufacturing and two auxiliary departments, and had been a vice president and a director of the company.

During World War II he played an important role in the company's part in the Government's atomic energy program that culminated in the design, construction and successful operation of the Hanford plutonium plant. It was his responsibility to maintain liaison between du Pont and the University of Chicago, translating the university's nuclear research developments into practical application at the Hanford Works. When the work had been completed, Mr. Greenewalt's contribution was summarized in the statement of General Leslie R. Groves that the project could not have been brought to a successful conclusion without his efforts.

Mr. Greenewalt holds many decorations awarded him for attainment in the fields of chemical engineering, industry, and management. A naturalist by avocation, he is also celebrated for his writings in the field of natural science.

ASCE Participates in Management Conference

Nearly 300 top management engineers attending the Ninth Annual Joint Engineering Management Conference, held in New York on September 14, heard talks on such diverse subjects as "Increased Profits Through Application of Computer Techniques," "The Economic Environment in Which Engineers Work," and "Human Relations Problems in the Management of Engineering." The program was oriented to the management of engineering functions rather than personnel management. Joint sponsors were the five Founder Societies, the American Institute of Industrial Engineers, and the Institute of Radio Engineers.

Roger Gilman, Director of ASCE and director of port development for the Port of New York Authority, was chairman of a session devoted to "Expanding Interests in Engineering."

Four of the conference papers have been reprinted and are available from the American Society of Mechanical Engineers (345 East 47th Street, New York 17). They are "Managing for Creativity in Engineers," "Management of Research and Development Personnel in an Industrial Laboratory," "Trans-Formation and Value," and "Increased Profits Through Applications of Computer Technology."

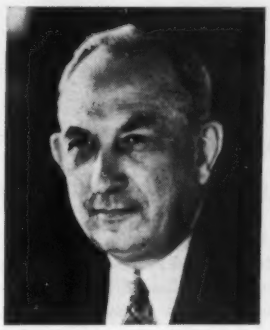
Highlight of the Friday luncheon was the presentation of the Gantt Gold Medal for 1961 to Lyndall Fownes Urwick, internationally recognized authority on management. The Gantt Medal—a joint award of the ASME and the American Management Association—is given annually for "distinguished achievement in management as a service to the community."

ASCE Membership as of October 13, 1961

Fellows	11,049
Members	16,978
Associate Members	19,711
Affiliate Members	125
Honorary Members	50
Total	47,913
(October 9, 1960	46,244)

ASCE Past President R. E. Dougherty Dies

Richard E. Dougherty, Past President of ASCE and retired vice president and assistant to the president of the New York Central, died in White Plains, N.Y., on October 6, at the age



of 81. A nationally known civil engineer, Mr. Dougherty served from 1949 to 1952 as one of two personal representatives of President Truman on the Commission for Renovation of the White House. He was also on the advisory board of the Public Works Project Task Force of the Hoover Commission on Reorganization of the Executive Branch of the Federal Government.

A civil engineering graduate of Columbia University, Mr. Dougherty taught there briefly before joining the New York Central staff in 1902. He was district engineer for the railroad's Eastern District from 1905 to 1918; designing engineer, Buffalo and West, from 1918 to 1924; and engineering assistant to the president from 1924 to 1930. In the latter year he was elected vice president, and in 1947 he became vice president-assistant to the president. After his retirement in 1951 he joined the New York City consulting firm of Seelye, Stevenson, Value & Knecht.

Mr. Dougherty was holder of many honors and awards—among them Columbia University's Egleston Medal and Citation for distinguished engineering achievement and the Columbia University Medal and Citation for Excellence. From 1935 to 1951, he was chairman of the Grade Crossing Committee of the Association of American Railroads. He had also headed many New York City civic and business groups.

Mr. Dougherty's many services to ASCE included terms as Director (1928-1930) and Vice President (1944 and 1945). He was president in 1948. His last service to the profession was as chairman of the Member Gifts Campaign of all the engineering societies for the United Engineering Center.

Highway Division Executive Committee Meets in UEC

The Highway Division Executive Committee—meeting in the Chi Epsilon Room in the new United Engineering Center late in September—reviewed the extensive work conducted by the 16 Division committees. Shown here, left to right, are Edward G. Wetzel, William A. Bugge (chairman), T. T. Wiley, and Thomas J. Fratar. As new appointees to the executive committee, Messrs. Wetzel and Wiley are attending their first meeting of the committee.

Rome Host to International Congress on Large Dams

Nearly 1,000 engineers from 44 countries assembled in Rome on June 26 for the opening of the Seventh International Congress on Large Dams. The total registration approached 1,500. The host country led with a registration of 220 engineers followed by 168 from France and 68 from the United States. Great Britain and Sweden were close behind.

More than 120 technical papers, 21 from the United States alone, had been prepared on the four questions selected for the session. These papers, distributed to the registrants for their review several weeks in advance of the Congress, formed the basis for the supplementary discussions presented in Rome.

On Tuesday afternoon technical discussions began on Question No. 24, "The Selection, Processing and Specification of Aggregates for Concrete for Large Dams," and continued on Wednesday afternoon with Question 25, "Underground Works in Connection with Large Dams." On Thursday morning, with G. T. McCarthy, F. ASCE, president of the U.S. Committee on Large Dams, presiding, topics relating to Question 26 were presented—"Modern Techniques of Concrete Dams for Wide Valleys and Ancillary Works." The concluding session, Thursday afternoon, with George E. Bertram, F. ASCE, USCOLD member, serving as general reporter, discussed Question No. 27, "Sealing of Earth and Rockfill Dams with Bitumen and Other Materials." From 15 to 25 discussions were heard on each question, some rather wide of the intended focal theme, and it was the consensus that more clearly defined questions for future Congresses would be advisable.

Much valuable reference material was assembled on each technical topic. Some data pertained to relatively new construction procedures, such as the use of vibratory roller compaction on nonplastic gravelly and stony materials. Discussion led to the conclusion that more reliable tests of the effect of aggregates on the behavior of concrete are obtained by testing aggregates as an element of concrete rather than separately.

Each question revealed areas where reliable measurement techniques and knowledge of deformation or settlement under load were in need of further development and experience. This need was notably brought out in discussions relating to the behavior of rock in heavily stressed foundations and where the rock mass is relieved from high natural stress as encountered in the excavation of large and deeply buried tunnels.

In general, technical participants reflected an attitude of more than usual caution in their outlook on extrapolation beyond present experience limits. Considered one of the most stimulating discussions of the entire Congress was that presented by Barry Cooke, F. ASCE, USCOLD member, who cited the need for more data on the behavior of large rockhill structures especially in view of the tendency to apply this type of construction to rapidly increasing heights.

The executive committee sessions were conducted under the able chairmanship of Dr. J. F. Rebelo Pinto, ICOLD's president for the past three years, assisted by M. Joseph Duffaut, secretary general. Responding to Great Britain's invitation for 1964, Edinburgh, Scotland, was selected as host to the Eighth Congress. The interim 1962 Executive Committee Meeting will be held in Moscow.

Claudio Marcello, F. ASCE, of Milan, was elected ICOLD's president for the ensuing three years, and the vacancy for the office of vice president from the Americas will be filled by Jack K. Sexton, F. ASCE, of Quebec, Canada, who was sponsored for this post by USCOLD. M. M. Gadein, M. ASCE, of Khartoun, Sudan, was elected to the position of vice president at large.

The Federation of Rhodesia and Nyasaland was admitted as the 46th member of ICOLD, but action on the application of South Korea was postponed.

At the close of the Congress the significant Italian dams—from the Alps to Sicily—were visited in a series of study tours, converging in Venice.

Plans Completed for UEC Dedication

Dr. Eric A. Walker, president of Pennsylvania State University, will be the principal speaker at the formal dedication of the new United Engineering Center on November 9.

A famous educator, recipient of high awards for war-time work and holder of a number of honorary degrees, Dr. Walker was named by President Eisenhower in 1957 as general chairman of the Conference on Technical and Distribution Research for Benefit of Small Business. He has been at Penn State since 1945 and was dean of the College of Engineering and Architecture from 1951 to 1956. In the latter year he was elected president.

Herbert Hoover, former President of the United States and Honorary Member of ASCE, is honorary chairman of the dedication committee for the November 9 ceremony. Mr. Hoover officiated, also, at the Center's

ground breaking and cornerstone proceedings.

Sharing the platform with the dignitaries will be an engineering honor student—William L. Hallerberg, of the Missouri School of Mines and Metallurgy. Mr. Hallerberg, who is specializing in metallurgy, will present his views of the challenge to the new generation of engineers as seen from the standpoint of young men now studying to enter that profession. He is accounted an excellent speaker.

The nineteen professional engineering societies sharing the 20-story United Engineering Center have been at work in their new headquarters since September 5.

Community Cooperation For Career Guidance

With the encouragement of the Construction Division of ASCE, the Philadelphia Section became first to sponsor a series of Construction Industry Conferences, to be held in major cities throughout the U.S. The conference, held Wednesday, October 11, at the Franklin Institute, in Philadelphia, attracted 350 selected outstanding high school students, together with guidance teachers, school administrators, public officials and representatives of the construction industry.

Demonstrating the cooperation of the various segments of the construction industry, the Philadelphia Section brought together chapters of the American Institute of Architects, the Pennsylvania Society of Professional Engineers and the General Building Contractors Association, as full participants in the planning and conduct of the activity. The Philadelphia Board of Education also participated by making possible the selection of students to be invited to the conference.

Participants were given a thorough briefing in the career opportunities in the construction industry, not only as civil engineers, but as architects, contractors, and skilled construction specialists of all sorts. A highly informative career guidance film prepared by the General Building Contractors was then shown. Bus tours to projects under construction were provided for those in attendance.

Representing the Construction Division in the conference was Carl B. Jansen, vice chairman of the Executive Committee, who presented a luncheon address on "Careers in the Construction Industry." Other talks on careers were given by Dr. Sidney Shore, representing the Philadelphia Section of ASCE, and Norman A. Rice, president of the Philadelphia Chapter, AIA.

Financing for the activities was provided by the General Building Contractors Association, Inc. Coordinator for the Philadelphia Conference was Capt. Richard N. de Charms, representing the Philadelphia Section of ASCE.

It is the objective of the Construction Division to plan and conduct conferences of this sort, using the Philadelphia conference as a pattern for its career guidance and public information program.

Papers from Cohesive Soils Conference

As announced in the August issue, the papers presented at the ASCE Research Conference on Shear Strength of Cohesive Soils, held at the University of Colorado in June 1960, are now available in a single, hard-bound cloth volume. In addition to the 26 Conference papers with discussions and closures, the volume includes the entire Conference proceedings.

The volume is priced at $10 a copy (no discounts this time), and there is a coupon for ordering on page 121.

ASCE ENGINEERING SALARY INDEX

Prepared Semiannually

Consulting Firms

CITY	CURRENT	PREVIOUS
Atlanta	1.38	1.38
Baltimore	1.16	1.14
Boston	1.26	1.23
Chicago	1.44	1.50
Denver	1.32	1.25
Houston	1.31	1.26
Kansas City, Mo.	1.26	1.19
Los Angeles	1.36	1.35
Miami	1.38	1.38
New Orleans	1.25	1.22
New York	1.30	1.29
Pittsburgh	1.11	1.07
Portland, Ore.	1.31	1.28
San Francisco	1.38	1.35
Seattle	1.13	1.13

Highway Departments

REGION	CURRENT	PREVIOUS
I, New England	1.03	1.03
II, Mid Atlantic	1.18	1.15
III, Mid West	1.32	1.26
IV, South	1.12	1.12
V, West	1.16	1.13
VI, Far West	1.20	1.16

Sole purpose of this Index is to show salary trends. It is not a recommended salary scale. Nor is it intended as a precise measure of salary changes. The Index is computed by dividing the current total of base entrance salaries for ASCE Grades I, II and III by an arbitrary base. The base used is $15,930, the total of salaries paid in 1956 for Federal Grades GS5, GS7 and GS9. Index figures are adjusted semiannually and published monthly in CIVIL ENGINEERING. Latest survey was June 30, 1961.

Contributions to UEC Will Be Welcome

Though many members of the participating societies have given freely to make the United Engineering Center possible, about $1,000,000 is still needed to complete the financing of this vital project. ASCE was the first of the original Founder Societies to meet its assigned quota ($800,000). However, only about a third of the membership of the Society was represented in this generous gift.

Contributions from the many who did not previously see their way clear to taking part in the financing of the Center and those who can give an additional amount will be more than welcome. Gifts, made payable to the United Engineering Trustees, Inc., are deductible for income tax purposes. A coupon to facilitate making a contribution to this vital project appears below.

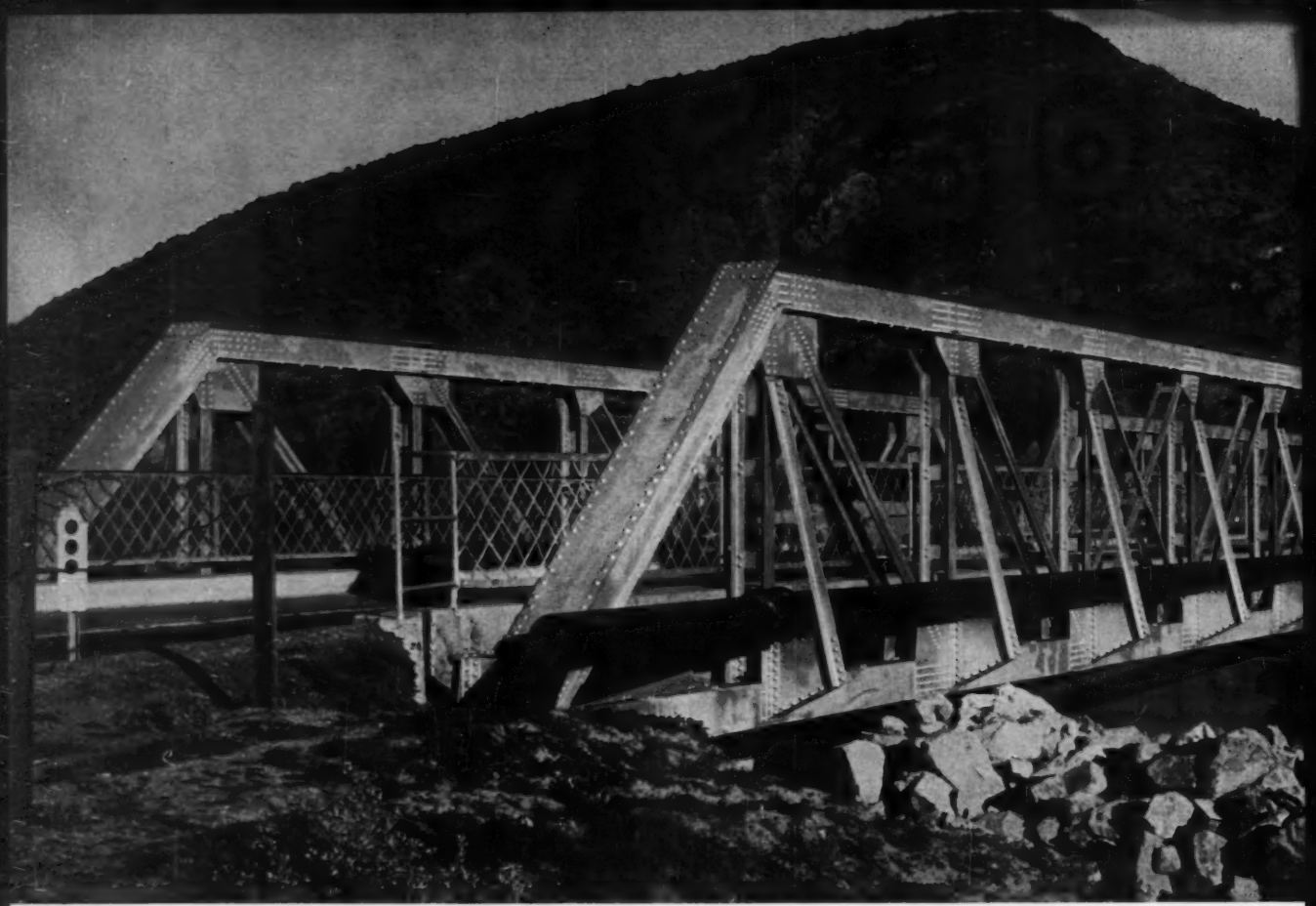
For completion of the
UNITED ENGINEERING CENTER
To Executive Secretary William H. Wisely
American Society of Civil Engineers
345 East 47th Street
New York 17, New York

Attached is my check for $..... payable to United Engineering Trustees, Inc. as my (additional) contribution to the new home for engineers.

Signed .....

Address .....

.....



Three-quarters of the "Old Town" Bridge is shown in use at its new site over Calleguas Creek, Ventura County.

How to make two new bridges from

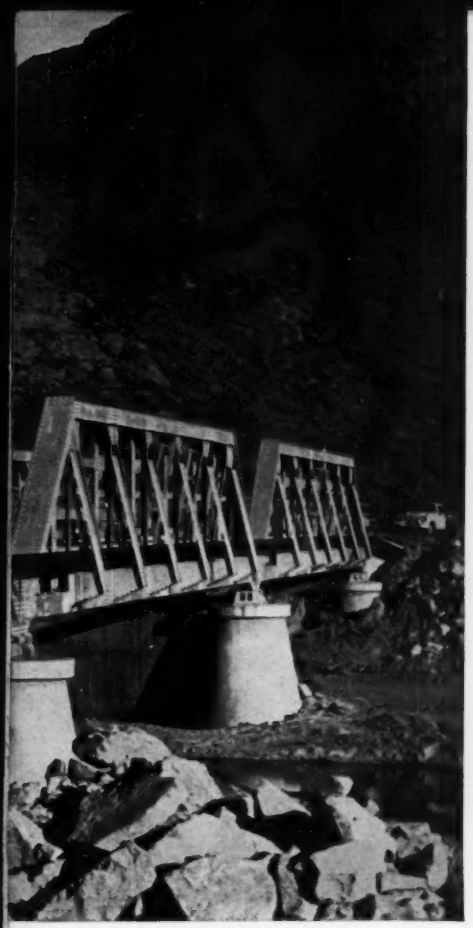
But don't try it unless you've got a steel bridge to start with.

When boom years came to San Diego and its suburbs, traffic zoomed. The "Old Town" Bridge you see at lower left was forced into retirement by the new four-lane, freeway-type steel bridge directly behind it.

So they sold the 35-year-old bridge

Even though it was 35 years old, the "Old Town" Bridge *still* met the specifications of the county and state bridge engineering codes for width, strength, and load-bearing capacity! So the city of San Diego sold it to Macco Construction

◀ *After serving San Diego well for 35 years, the "Old Town" Bridge was dismantled . . . but not discarded. Within two months it became the two bridges you see above. (Bethlehem Steel fabricated and erected all the steel for all the bridges you see in these photos.)*



One-quarter of the "Old Town" Bridge now crosses a creek bed in Foster Park, Ventura County, California.

one old one... and save $30,000!

Company, who dismantled the bridge and, in turn, sold it to the Bailey Bridge Equipment Company of San Luis Obispo. This company then sold the bridge to Ventura County highway authorities to build *two* urgently needed bridges.

They trucked bridge trusses 200 miles

The 8 dismantled bridge trusses were trucked 200 miles northward. One truck was needed for each of the 18-ton, 104-foot-long trusses; two other trucks hauled the steel floor sections of the bridge.

The whole job took just 2 months

In Ventura County, three spans of the old four-span bridge were erected to span Calleguas Creek. The fourth span was erected to span Coyote Creek. One bridge was now two bridges! And the whole operation—from beginning of dismantling to finish of re-erection—had taken only two months!

SAVED $30,000

According to highway officials of Ventura County, the bridges are as good as new ones . . . and they cost $30,000 less than the estimated cost of building new bridges.

What other bridge material is as adaptable as steel?

You can *widen* a steel bridge—easily. You can *re-use* structural steel. And you can *scrap* structural steel and get something back on your original investment. Steel is the *adaptable* bridge material. Our nearest sales office will gladly tell you more.

Look to the future
...design with steel

Steel

for Strength
... Economy
... Versatility

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA. *Export Sales: Bethlehem Steel Export Corporation*

BETHLEHEM STEEL

BETHLEHEM STEEL

NOTES FROM THE LOCAL SECTIONS

(Copy for these columns must be received by the fifth of the month preceding date of publication)

Under the leadership of Prof. Ernie Harris, F. ASCE, of Fenn College, the **Cleveland Section's** Professional Advancement Committee has distributed 100 volumes of "What Does a Civil Engineer Do?" to junior high schools in the area. This has aroused enthusiasm in some of the schools in the form of requests for career guidance and a call has gone out to Section members to speak to junior high students on civil engineering. Volunteers, who wish to take advantage of the opportunity to render concrete service to the profession, should contact Professor Harris at Fenn College.

The **Los Angeles Section** is planning to participate in a joint Committee for Public Action. In addition to the Los Angeles Section, the Committee would include representatives from the three other ASCE Sections in California—San Diego, San Francisco and Sacramento. The HARM Committee—named after the initials of its members, Philip Helsley, Philip Abrams, R. Robinson Rowe, and William Moore—finds the coordination of the four Sections highly desirable for unified and timely action on statewide matters, especially where legislation affecting civil engineers is involved.

This fall **Metropolitan Section** members have an opportunity to take two business courses at special "insider" rates. The courses, "Accounting and Profit Planning for Engineers and Executives" and "Methods of Business Control Using Mathematics," are running for 10 weeks each, with one two-hour session per week. This is but one more indication of the important professional services available to Society members through their Local Sections.

LOCAL SECTIONS MEETINGS

Florida—The Cape Canaveral Branch will be host to the Section's annual meeting at the Starlite Paladium, Cocoa Beach, on December 9. Beginning at 12 noon, the program will include two sessions.

Metropolitan—Regular monthly meeting in the United Engineering Center, New York, third Wednesday in each month, at 7:00 p.m. Dinner in UEC Cafeteria at 5:30.

Philadelphia—Joint meeting with the American Society of Mechanical Engineers at the Engineers' Club, Philadelphia, on December 12, at 7:30 p.m., preceded by cocktails and dinner at 5:30 p.m. and 6:30 p.m., respectively.

Sacramento—Weekly luncheon meetings at the Elks Temple every Tuesday, at 12 noon.

St. Louis—Regular monthly luncheon meetings at the York Hotel on the fourth Monday of each month, at 12:15 p.m.

Dr. G. Brooks Earnest, newly elected President of ASCE and long-time president of Fenn College, was speaker at a joint meeting of the Alaska Section and its counterpart in the American Society of Mechanical Engineers. This photo, taken at the meeting held in the Elmendorf Air Force Base Officers Club, pictures (front row, left to right) Frank Nyman; James Anderegg, president of the Anchorage Branch; Miss Mildred Butler; Dr. Earnest; Wesley H. Butler, president of the Alaska Section; and John L. Cerutti. In back row are Oliver V. Kola, Joe Hayes, Leo E. Obermiller, Lamar Hubbs, A. R. Soliss, D. Boyd Slawson, Section Secretary Alfred Bruck, Alaska Section, and Robert Lee.

ASCE CONVENTIONS

HOUSTON CONVENTION

Houston, Tex.
Hotel Shamrock Hilton
February 19-23, 1962

NATIONAL WATER RESOURCES ENGINEERING CONFERENCE

Omaha, Nebr.
Hotel Sheraton-Frontenelle
May 14-18, 1962

ASCE ANNUAL MEETING AND NATIONAL TRANSPORTATION ENGINEERING CONFERENCE

Detroit, Mich.
Hotel Statler Hilton
October 8-12, 1962

DISTRICT CONFERENCES

PACIFIC SOUTHWEST COUNCIL

San Diego, Calif.
El Cortez Hotel
April 5-7, 1962

PACIFIC NORTHWEST COUNCIL

Seattle, Wash.
Olympic Hotel
April 20 and 21, 1962

DISTRICT 9 COUNCIL

Indianapolis, Ind.
Marott Hotel
May 4 and 5, 1962

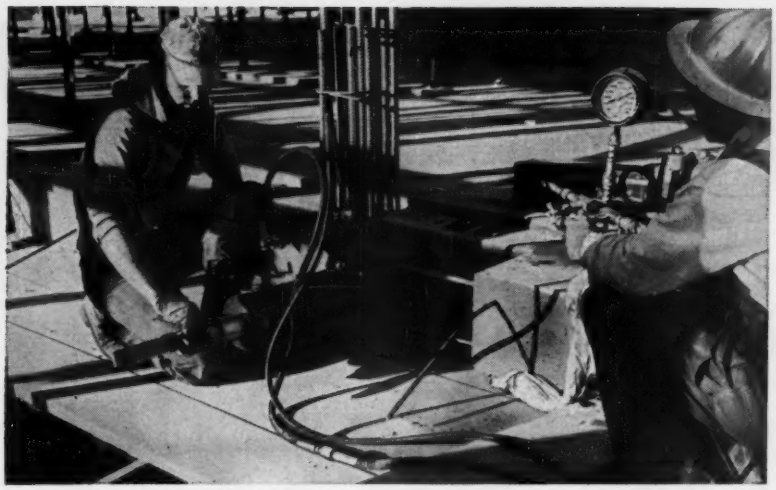
TECHNICAL DIVISION MEETINGS

ENGINEERING MECHANICS DIVISION CONFERENCE

Austin, Tex.
University of Texas
April 26 and 27, 1962
Sponsored by
Engineering Mechanics Division

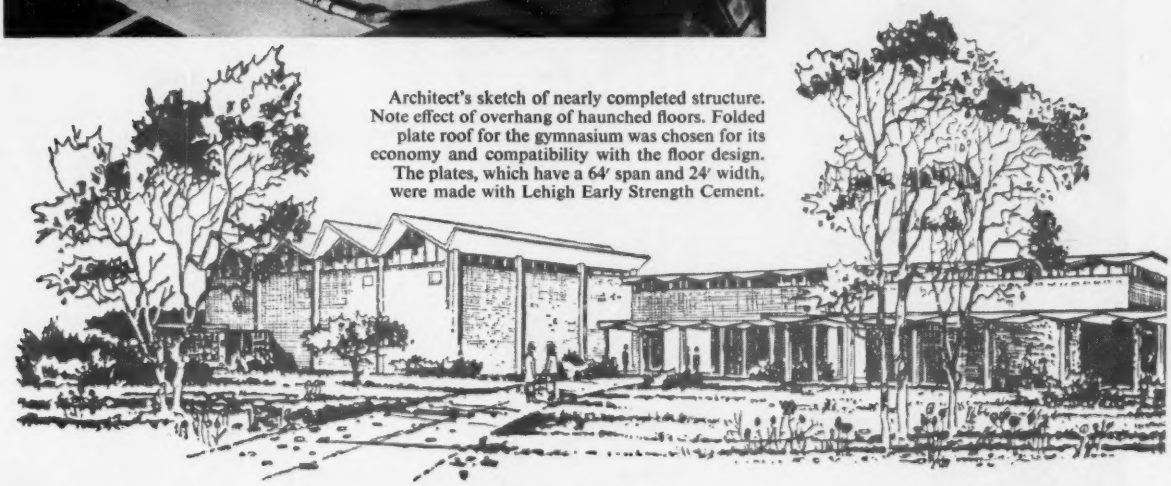
NATIONAL CONGRESS ON APPLIED MECHANICS

Berkeley, Calif.
University of California
June 18-21, 1962
Co-sponsored by
Engineering Mechanics Division



Post-Tensioned Concrete Floors for new school

Floors were poured in sections. As concrete in each section reached 3500 psi, post-tensioning was applied. Thickness of floors varied from 6″ to 12″.



Architect's sketch of nearly completed structure. Note effect of overhang of haunched floors. Folded plate roof for the gymnasium was chosen for its economy and compatibility with the floor design. The plates, which have a 64′ span and 24′ width, were made with Lehigh Early Strength Cement.

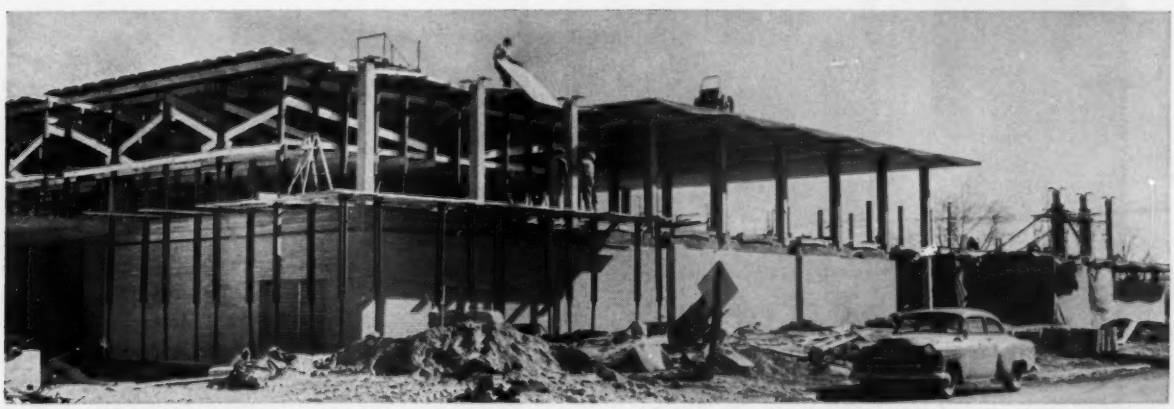
● For both economy and looks, an ingenious floor and roof design was created for Colby, Kansas' new Junior High School. Lightweight post-tensioned haunched slabs made possible a savings in material costs and provided great flexibility in the allocation of floor area. A folded plate roof for the gymnasium adds to the fresh overall appearance of the finished job.

Lehigh Early Strength Cement speeds winter construction. To meet the fast winter construction schedule, the use of early strength cement in the slabs was, in the contractor's words, "The only answer consistent with economy." With Lehigh Early Strength Cement, the slabs reached tensioning strength in one half the usual time, keeping the job on schedule with multiple use of a single set of forms. In addition, the reduced curing time meant savings on *winter* protection costs.

This job is another example of how modern concrete construction and Lehigh Early Strength Cement offer almost unlimited opportunities for design freedom, construction economy and attractive appearance. Lehigh Portland Cement Company, Allentown, Pa.

Architect: Mann and Company, Hutchinson, Kansas
Contractor: L. R. Foy Construction Co., Hutchinson, Kansas

LEHIGH CEMENTS



Concrete for first and second floor and roof was made with a lightweight aggregate and Lehigh Early Strength Cement. The haunched design added to the overall architectural effect as well as contributed to the saving of materials. Lehigh Mortar Cement was used for all masonry.

TWO STORIES OF INTERLOCKED STEEL frame the 320′ wide, 25′ high, middle section which houses two department stores. Standardized, interlocking girders and purlins required no bolting, riveting or field welding — reduced engineering, fabrication and construction costs — advanced completion and occupancy dates.

COMPLETELY FIRE-RESISTANT CONSTRUCTION. Masonry fire wall partitions rise unhampered through MACOMBER METAL DECK roof via double framing at roof line. V-LOK columns were embedded in walls. Open web purlins and girders made sprinkler installation easy.

870 FOOT LANDSCAPED CENTRAL CONCOURSE boasts bench-filled garden and rest areas. Two-story, 25′ ceiling height, enclosed building — featuring arcade-type display windows — is focal point of concourse. Canopied retail units surround area.

1300 tons of high-strength MACOMBER **V-LOK** frame 350,000 sq. ft. Great Lakes Mall at Mentor, Ohio

The Edward J. DeBartolo Co. of Youngstown, Ohio — designers and builders — specified Macomber V-LOK in planning their latest of over 70 shopping centers. Previous and extensive experience with Macomber V-LOK — its speed, rigidity, and economy — was so much to their satisfaction that no other methods were considered.

When fully completed, the project will comprise 50 units on 14 acre tract. Paved parking for 5,000 cars will be provided.

V-LOK is ideal for shopping centers, industrial buildings, schools, warehouses. Write today for your comprehensive MACOMBER V-LOK MANUAL.

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CE -6110

THE YOUNGER VIEWPOINT

Committee on Younger Member Publications

Walter D. Linzing, Chairman; 4751 No. Paulina, Chicago 40, Ill.

Zone I	Zone II	Zone III	Zone IV
Donald Kowtko 289 Foxhill Road Denville, N. J.	Russel C. Jones 2020 Delaware Avenue Pittsburgh 18, Pa.	William R. Walker 4600 Franklin Ave. Western Springs, Ill.	Judd Hull 6000 S. Boyle Ave. Vernon, Calif.

This month's editor is Associate Member Russel C. Jones, new committee member representative for Zone II. Mr. Jones is currently enrolled as a doctoral candidate at Carnegie Institute of Technology in Pittsburgh. He has previously been employed as a structural designer for a small consulting firm, and as a research engineer for the missile division of a major aircraft company in California.

Key question—graduate school study?

Today, more than ever before, the question of whether to include graduate study in his career plan must be squarely faced by the young engineer. Whether he is an undergraduate student approaching graduation or a recent graduate making his first real contact with the business world, the young engineer cannot afford to overlook the effect which inclusion—or omission—of graduate study might have on his professional qualifications. The remarks that follow are intended to give the two sides of the question, and to offer ideas on how graduate school might be worked into a career plan.

Making the decision

Should a civil engineer start his career with a B.S. degree, or should he first obtain additional education in a graduate-study program? One major consideration in answering this question is a critical review of the completeness and scope of the training obtained in the engineer's undergraduate study. Some institutions aim their programs at generally preparing the student for immediate entrance into the business world, while others stress basic studies to prepare the student for graduate study. When the young engineer stands at the fork in the road, he must consider whether the education he has thus far obtained has given him an adequate base from which to travel on through the forty or fifty years of work in his chosen area of the profession. It goes without saying that an engineer is always required to continue his studies (formal or otherwise) to keep abreast of developments in his field and in order to reach his full potential. It might be advisable for him to talk with practicing engineers to see what will be expected of him. In some areas of the profession, such as teaching, research, and advanced design, an advanced degree is practically a necessity. In other areas, graduate study can be a real advantage, but it is not a requirement for a successful engineering career.

Advantages of graduate study

Graduate study offers several advantages to engineers who include it in their career plans. The additional study can fill in the gaps left in the undergraduate curriculum, and give a more basic understanding of the world of engineering and science. This gives the advanced-degree graduate a broader foundation on which to build his knowledge and experience during his career. An advanced degree thus better prepares the student to take his place in the business world, and this will be reflected in his bargaining position as he seeks employment. It may be worth sacrificing comfort and security for a few years in order to better prepare for the career that will occupy an entire lifetime.

Some drawbacks, too

On the other hand, going to work after earning the B.S. degree allows more immediate realization of financial and professional goals. The financial drive and the desire for practical experience have generally already been shelved for the four undergraduate years, and further postponement of entry into the business world may not always be desirable for the student. It is also claimed that some career areas cannot be advanced in the university but require field training.

Evaluating your abilities

The limitation of personal ability and the desire for more education must be carefully evaluated by each student considering graduate study. A new responsibility on the part of the student is required in graduate school. He will have to acquire information not available in formal courses and will have to get more of the answers for himself. Graduate-study competition is much tougher than in undergraduate courses, but it also means that the student has a more stimulating group to associate with. An engineering student can find out if he has what it takes for advanced study by reviewing his undergraduate grades, talking with faculty and other engineers, and perhaps taking additional tests.

One other point to keep in mind is the inherent flexibility in choosing graduate school. The choice of what area of the civil engineering profession to enter is virtually made once the engineer accepts a job, but this choice remains open for a number of years if he enters graduate school. It is quite possible that with additional studying and maturing an entirely different field will command the interest of the graduate school student.

When to take graduate studies

Having decided to undertake graduate study, the young engineer is next faced with the problem of when to include it in his career plans. If maturity is proportional to age, the student may be better prepared to benefit by graduate training some years after earning his B.S. degree. On the other hand, fewer of the academic routines will be forgotten if graduate school is started as soon as possible.

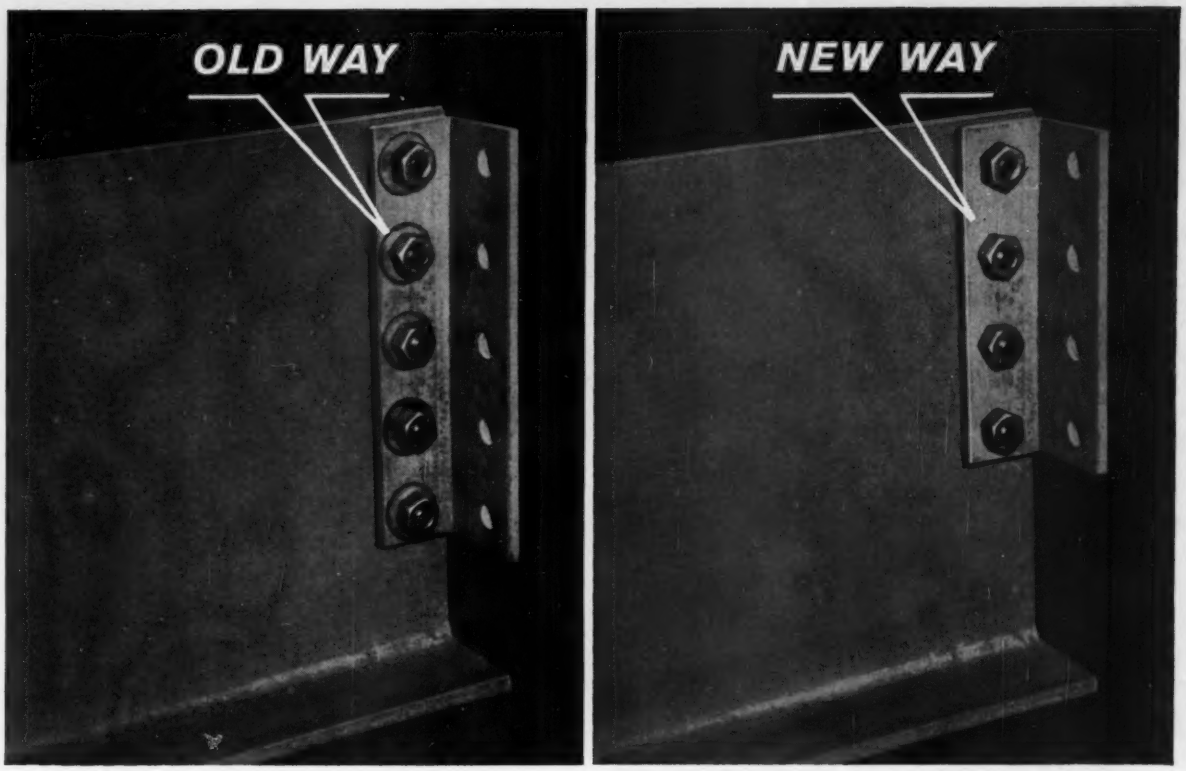
Work for the young engineer before starting full-time graduate study can have other than financial advantages. If he leaves his undergraduate college, he is more likely to return to a different school for graduate study—a factor that is often advantageous. A period of work in industry can also be helpful in guiding the student in his choice of an area for graduate study, and hence assisting in the selection of a school. The experience of working for a time is sure to increase the student's appreciation of graduate school and add to the benefits he derives.

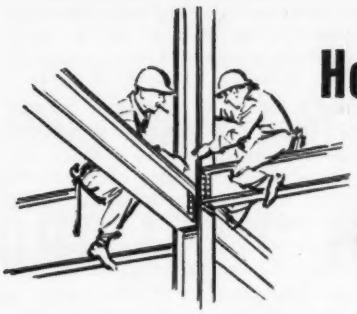
The danger of working for a period before returning for graduate study is that the advantages of staying on the job may overshadow study plans. Such factors as salary level, retirement arrangements, seniority status, and the possibility of promotion may combine to make the security of a job seem much more important than an advanced degree. Then, too, family obligations and other commitments may reach a point where full-time graduate study would not seem feasible.

It is generally agreed that graduate study is of greatest value when it can be undertaken in full-time residence at a graduate school. The research resources, the personal relationships with faculty and other students, and the total immersion in an academic atmosphere contribute to maximum educational gain. Part-time programs geared for engineers who are simultaneously working full time seldom are as effective.

Opinions invited

The writer has probably presented a somewhat slanted viewpoint because of the road he has chosen to follow when faced with the graduate-school question. Young engineers who have chosen or are contemplating other roads are invited to express their ideas here in "The Younger Viewpoint."





How RB&W A325 bolts can cut connecting costs 15% on one beam alone

Merely changing the way end clips are bolted to both ends of beam pictured not only can cut connecting costs in the fabricator's shop but also in field erection.

This saving is based on an original cooperative study by RB&W and a large midwestern steel fabricator. As now permitted by the new specification, four new heavy-head, short-thread A325 structural bolts replace five regular high-strength bolts in each end. The result: 12 out of 20 washers and 2 out of 10 bolts disappear from two joints. Operating and material cost drops 15%. Shop productivity increases.

Actually, material savings to *40%* are possible with the new bolt in bearing-type connections. That's because you can use two RB&W heavy-head A325 bolts and two washers instead of three regular high-strength bolts and six washers when there are no threads in the shear planes of the connection.

Cost reductions start with the structural engineer who designs joints. When he applies this approved 2:3 substitution, shop fabricators and field erectors benefit, and can come through with lower bids.

So familiarize yourself with technical-economic advantages of this better connecting method and a digest of the latest Research Council specifications. Write for Bulletin HHS-1. "How To Use and Specify the New High Strength Bolts." Russell, Burdsall & Ward Bolt and Nut Co., Port Chester, N.Y.

RB&W
117th year

Plants at: Port Chester, N. Y.; Coraopolis, Pa.; Rock Falls, Ill.; Los Angeles, Calif. Sales office and warehouse at: San Francisco, Calif. Sales offices at: Ardmore (Phila.), Pa.; Pittsburgh; Detroit; Chicago. Sales agents at: Cleveland; Milwaukee; Denver; Fargo.

LARGEST INDEPENDENT PRODUCER OF HIGH STRENGTH BOLTS FOR CONSTRUCTION

BY-LINE WASHINGTON . . . . .

Engineers got a wrist-slapping from Washington newspapers, in a controversy over location of a new disposal plant for the Washington Suburban Sanitary Commission. The Commission wanted to build the plant on the Potomac shore, exactly opposite Mt. Vernon, but ran into heavy opposition from many who thought it would be a desecration. Said a local newspaper, "The . . . Commission is run by a staff of excellent engineers. This is at once its greatest virtue and most dangerous shortcoming, for it insists on deciding every question on engineering criteria alone . . ."

* * *

With Congress finally out of town (until January), Washington attention now shifts to the Supreme Court, which opened its fall term with a record number (more than 1,000) of cases on its docket. None of the cases so far listed directly affects civil engineers, but a half-dozen or more will have a profound effect on the construction industry. All of them deal with labor relations—such questions as the right of injunction against unauthorized strikes; whether seniority follows a worker from job to job; legality of "agency shops" under state right-to-work laws. In addition, there are several civil-rights questions involving construction labor unions.

* * *

On labor, incidentally, the next session of Congress will take up Senator McClellan's S. 2573, which would put labor unions under some restrictions of the anti-trust laws—particularly to prevent any possibility of a nationwide strike against transportation facilities of any kind.

* * *

As to Congress, you could sum up the first session of the 87th Congress with the words "no surprises." As expected, Congress concentrated heavily on legislation of national character; generally showed its conservative cast by balking at relinquishing any purse-string power to the Executive; fought hard for states' rights in many areas; and fought especially hard over public-power proposals. (On public power, proponents lost a big one when Congress refused to OK any funds for the $95 million Hanford reactor; won a smaller one with approval—with some limitations—of federal construction of power lines for the Upper Colorado project.)

For construction, Congress approved just about the $7 billion-odd in direct appropriations forecast in the January budget messages—the bulk of this money going, as usual, to the Corps of Engineers, Bureau of Reclamation, and for military construction. Some of the changes forced by Congress, however, could have an effect on orderly planning of public works—notably the year-to-year financing in the $150 million (for two years) airport-aid bill, and the prohibition on any treasury-financing of public works for the next year.

Congress did pass two measures of importance to construction: It approved the new Delaware River Basin Compact—a powerful organization which can build new projects and regulate almost all uses of water in its area, and which has a federal commissioner with a full vote, and it approved a $75 million, six-year extension of the de-salinized water research program that wasn't exactly what the Administration had sought, but insures added research and construction work.

For engineers, specifically, Congress did very little. It eliminated the office of Commissioner of Public Roads, in favor of the new title, "Deputy Federal Administrator," and made provisions in the foreign aid bill (see October column) which would, at least, make it possible for an engineer to head up international development work.

* * *

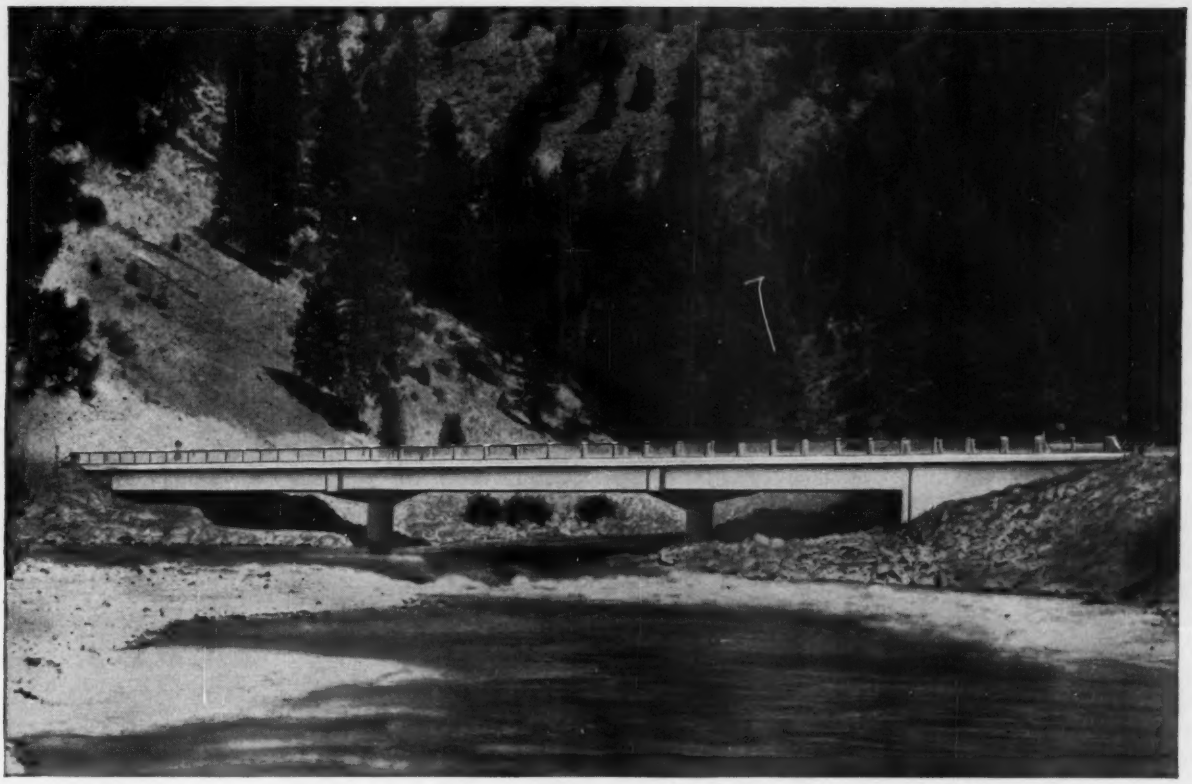
However, as predicted, many other matters were left hanging for next session: Revisions in tax laws to aid the self-employed; changes in the Civil Service status of engineers and other technical government employees; raises in pay for private consultants working with government agencies; establishment of the office of "Public Works Coordinator" to regularize government operations in this area, and others.

You can also add to the list of "unfinished business" the Oceanography program; establishment of departments of Urban Affairs and Transportation; the so-called "wilderness" bills (passed by the Senate, stalled in the House); establishment of bridge-clearances over the Upper Mississippi River, and many others.

In all, Congress wound up its longest session in ten years by appropriating a total of more than $93 billion—largest ever in peacetime, but more than half of it for defense purposes. Some of this money must of course "rub off" on construction, as industry gears to support an accelerated defense program. However, the very size of the total is a flag to many in Congress who fear runaway inflation. So it may serve as a brake on money next session.

* * *

After ten years of "growing up" under the National Academy of Sciences-National Research Council, the Building Research Institute will strike out on its own as an independent technical society in mid-1962. The Institute—a constituent part of the NAS-NSF's Division of Engineering and Industrial Research—will seek its own office space and a new organizational identity probably after the end of the parent body's fiscal year on June 30, 1962. Meanwhile, according to Leon Chatelain Jr., BRI president, there will be no basic changes in the organization, its membership or basic objectives. Rather, he said, the change will spur further activity in building research and administration of cooperatively sponsored research projects. The Institute will continue to function as a membership organization, publishing technical reports and holding its semiannual correlation conferences.



274′ Continuous Girder Bridge over South Fork of Payette River, Boise County, Idaho
Designers: Bureau of Public Roads
Contractor: Hansen & Parr Construction Co., Spokane, Wash.

Increase the effectiveness of your highway budget with

Monolithic REINFORCED Concrete

Keep the cost of your highway structures down by designing for reinforced concrete. Recently published cost figures for 14,703 federal aid bridges show that 2 out of 3 bridges were constructed of reinforced concrete at an average of approximately *$350.00 less per lineal foot* than bridges constructed with other materials. On your next project, investigate this lower cost construction material and compare its savings.

Concrete Reinforcing Steel Institute
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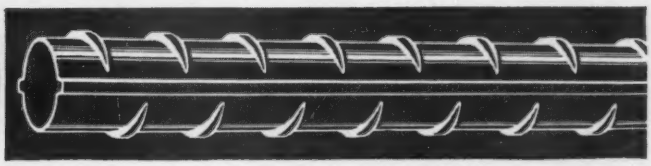
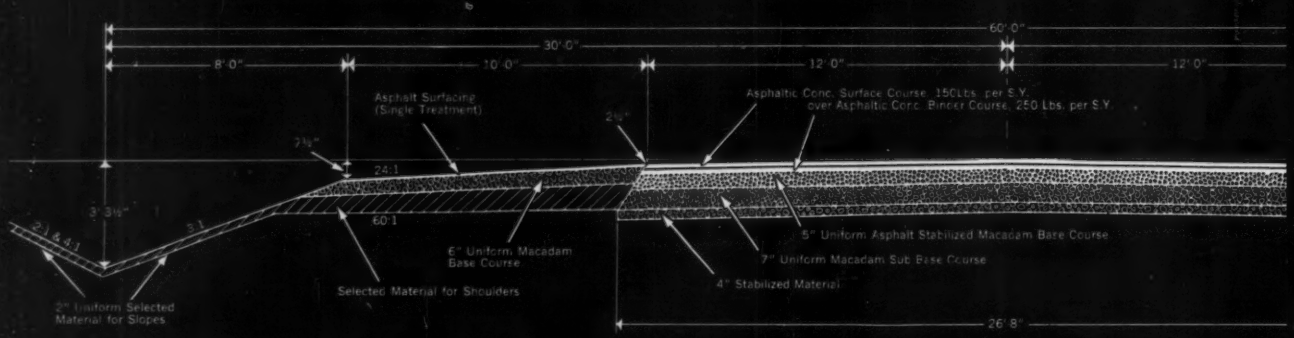


9-61

New DEEP STRENGTH Asphalt Section of South Carolina Interstate No. 26 extending from Route 296 to U.S. Route 176

MACADAM SUBBASE course is spread and compacted to 7-inch thickness.



New Section of South Carolina

Interstate No. 26 uses DEEP STRENGTH Asphalt Construction

The expanding pattern on the National System of Interstate and Defense Highways is nowhere shown to better advantage than in the State of South Carolina, particularly regarding mileage under contract and mileage constructed. Of the approximate 680 Interstate miles in this state, some 325 miles are under contract. About 180 miles are in the latter stages of construction or open to traffic.

This record is the result of a combination of important factors, among which may be mentioned careful planning, an aggressive and intelligent group of State Highway Engineers, and the adoption of *stage construction* wherever feasible. Last but not least, the use of Asphalt in combination with local aggregates to reduce costs, speed construction, and give the State a highway system which is durable, smoother-riding, and well able to support any traffic loads of the foreseeable future.

An excellent example of South Carolina Interstate Highways is a section of I #26 in the vicinity of Spartanburg. Rainfall and temperatures are normal for the Southern region, and frost conditions are not a serious factor. The design includes a selected top-soil sub-grade, reinforced with crusher-run stone, an Asphalt-primed macadam subbase course, an Asphalt plant-mix macadam base and an Asphalt concrete binder and wearing course.

Asphalt base was a plant-mix macadam with aggregate graded from the No. 4 sieve to 2½ inches, heated and coated with 3% to 4% of 85-100 penetration Asphalt, laid 5 inches thick in one layer. (Recent contracts specify a smaller stone constructed in two layers.)

Shoulders follow the general criteria for the Interstate system, with 10-foot surfacing for the outside lane and 3-foot for the inside lane. Features that materially reduced shoulder costs were the use of selected material for the foundation course with a 6-inch uniform macadam base and an Asphalt single-surface treatment with ½-inch stone for cover.

Compaction was performed on the pavement structure with three wheel steel rollers, high contact pressure pneumatic tire rollers and tandem steel wheel rollers.

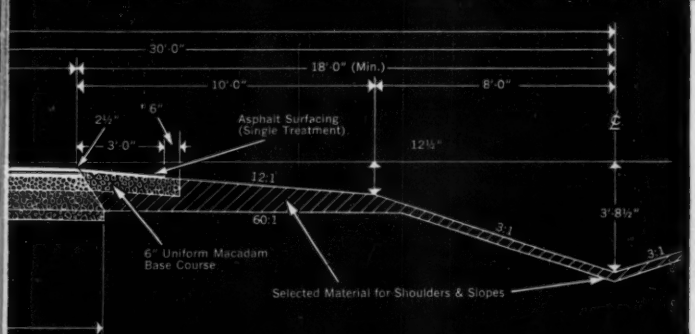
A study of the section below shows how this DEEP STRENGTH Asphalt design assures heavy-duty strength and durability. This application of DEEP STRENGTH Asphalt design principles is the result of many years of study, research, and experience in using local materials in combination with Asphalt by engineers of South Carolina's State Highway Department. Their invaluable engineering experience has saved many millions of taxpayer-dollars and provided extra mileage of Interstate Highways.

A new edition of the ASPHALT HANDBOOK incorporates all the Advanced Design Criteria implied in the term DEEP STRENGTH Asphalt Pavement. Write us for your free copy.

MULTI-LAYER SECTIONS consolidated for smoother riding by high contact pressure pneumatic tire rollers.

35-foot DEPRESSED MEDIAN with deep longitudinal drains assures good drainage and lowered water table.

THE ASPHALT INSTITUTE College Park, Maryland



HERE'S THE DEEP STRENGTH DESIGN OF SOUTH CAROLINA INTERSTATE NO. 26:

—A.	A. Asphalt concrete wearing course	1½"
—B.	B. Asphalt concrete binder course	2½"
—C.	C. Asphalt stabilized macadam	5"
—D.	D. Asphalt primed macadam subbase course	7"
—E.	E. Stabilized material	4"
—F.	F. Subgrade or Improved Subgrade	—
	TOTAL THICKNESS	20"

News Briefs . . .

Cooper Union Dedicates New Engineering Center

Cooper Union's new building for its School of Engineering was dedicated on September 15. In the dedication address, Richard G. Folsom, president of Rensselaer Polytechnic Institute, told an audience of several hundred that engineering schools must keep up with the accelerating pace of the engineering profession and must avoid "preparing our students for careers of the past decade rather than for careers two or three decades ahead. We are going to have to educate more people faster and longer," he said. "Somehow we must build into our profession a greater responsiveness to new knowledge. And we must make education a full and participating partner with professional practice and research."

An unanticipated, but welcome, feature of the ceremonies was an appearance by former President Herbert Hoover, Hon. M. ASCE. In a brief speech, Mr. Hoover referred to Cooper Union as a pioneer in free, privately supported education and in professional engineering instruction. He also remarked, "Once in engineering, you never intellectually get out of it. You may get on the slippery road of public service, but you are still an engineer."

Cooper Union's new Engineering Building, the third in its one hundred-year history, will permit housing under one roof for the first time all the departments in the famous tuition-free engineering school. Erected just north of the original Cooper Union Foundation Building in the Astor Place area of Manhattan, the $4,000,000 center, of steel and concrete faced with brick and stone, provides 100,000 sq ft of office space.

Voorhees, Walker, Smith, Smith and Haines were the architects, and Vermilya-Brown Company, Inc., the general contractor. Charles F. Peck, Jr., F. ASCE, head of Cooper Union's civil engineering department, worked on the structural design in cooperation with the architect.

Construction Spending Rises in September

Spending for new construction this September amounted to $5.4 billion, a small increase over expenditures for August and a 5 percent increase over spending in September 1960. Estimates are from the Department of Commerce's Bureau of the Census, which reports that a slight August-September decrease would have been normal for the period.

Contributing to September expenditures were $3.7 billion in private construction, matching the August level but 5 percent above September 1960 private construction expenditures. Public construction spending, at $1.7 billion, was about 3 percent above the August level and also 3 percent above last year's level.

Cumulative spending in the first nine months of 1961 came to $42.3 billion, in comparison with $41.3 billion spent in the same period of 1960. Slight increases in both private and public expenditures were represented in this total. However, private residential construction was off 3 percent from last year in the past nine-month period.

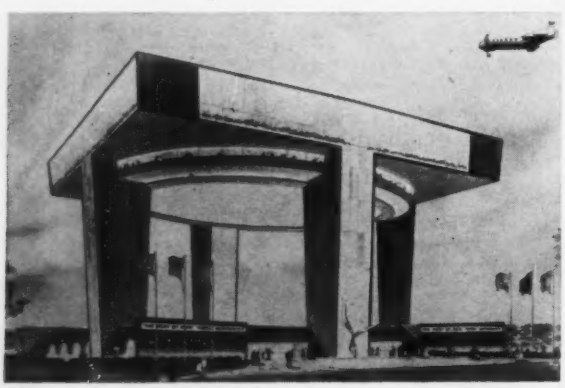
Training Courses Offered In Radiological Health

Engineers, public officials, and others concerned with radiological health will be interested in basic training courses soon to be offered at the Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio. The sponsoring organization is the U.S. Public Health Service through its Division of Radiological Health.

A two-week training course in "Basic Radiological Health," set for January 15-26, will cover the basic nuclear physics necessary for a technical understanding of radiological problems in public health work, major sources of radiation exposure, modes of radiation injury, and units and terminology associated with the new field. Completion of this course is recommended as desirable basic training for persons interested in a one-week training course in "Radioactive Pollutants in Air," scheduled for January 29-February 2. The latter course will provide instruction in air-monitoring techniques (including meteorological aspects), in sampling and analysis, and interpretation of data. One-third of the time will be devoted to problem sessions and laboratory practice. From February 5 through 16 there will also be related courses on "Radioactive Pollutants in Water" and "Radionuclides in Water."

Full information on the courses is given in the Training Program Bulletin, which may be obtained from the Chief, Training Program, Robert A. Taft Sanitary Engineering Center, 4676 Columbia Parkway, Cincinnati 26, Ohio, or from any PHS regional office.

Heliport to Top Exhibit Building at New York World's Fair



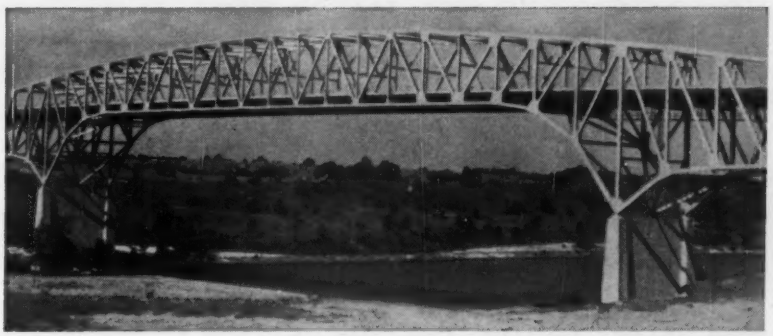
New York-New Jersey Exhibit Building for the New York World's Fair will be topped by a 120-ft-high heliport, the air gateway to the fair. The $2,400,000 project, shown here in artist's rendering, will be built by the Port of New York Authority on a 1¼-acre site between the two principal entrances. New York Airways, Inc., will provide express shuttle air service between Manhattan and Port Authority airports and the fair. On the two floors below the heliport, there will be the official World's Fair restaurant and an observation deck. These three top floors will be supported by four mammoth tapered columns rising from the Port Authority's 26,000-sq-ft ground-floor exhibit area. Elevators will be housed in the columns. Project will be completed in January 1964, three months before the opening of the fair.

AISC Honors Beautiful Steel Bridges Opened in 1960

Four bridges in four different categories have been designated the most beautiful steel bridges opened to traffic in the United States in 1960. The prize-winning structures, plus four receiving honorable mention, were selected in an annual competition sponsored by the American Institute of Steel Construction, a national association representing the fabricated structural steel industry. The prize-winning structures were chosen from 89 entries located in 27 states.

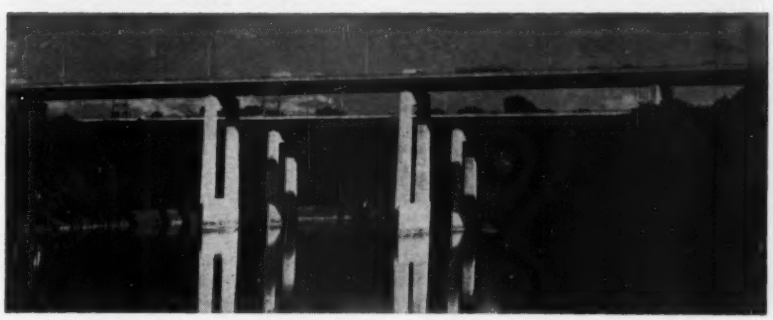
In special ceremonies, to be arranged at the sites later this year, stainless steel plaques will be affixed to the four top prize winners: **Class I** (for bridges with spans of 400 ft or over), the Summit Bridge over the Chesapeake and Delaware Canal at Summit, Del., designed by J. E. Greiner and fabricated by the American Bridge Division of U.S. Steel; **Class II** (for bridges with fixed spans under 400 ft and costing more than $500,000), the Roosevelt Boulevard Bridge over the Schuylkill River at Philadelphia, designed by Richardson, Gordon & Associates and fabricated by the Bethlehem Steel Company; **Class III** (for bridges with spans under 400 ft and costing under $500,000), Cemetery Access Bridge at Milwaukee, Wis., designed by Howard, Needles, Tammen & Bergendoff and fabricated by the C. Hennecke Company; and **Class IV** (for bridges with movable spans), Rio Vista Bridge over the Sacramento River at Rio Vista, Calif., designed by the Bridge Department of the California Division of Highways and fabricated by the Judson Pacific-Murphy Corporation Division of Yuba Consolidated Industries.

Certificates of honorable mention will be awarded to two bridges in **Class II:** Bonner Springs Bridge at Bonner Springs, Kans., and Mansfield Reservoir Bridge at Hollandsburg, Ind.; and to two in **Class III:** North Fork Consumnes River Bridge, near Placerville, Calif., and the Grand River Bridge, near Harpersfield, Calif.



Summit River Bridge is the winner in Class I. The jury praised the "long, low silhouette and graceful arch of the through-truss design that blends harmoniously with the gently rolling countryside."

Roosevelt Boulevard Bridge, winner in Class II, was praised for "the excellent balance between the steel girders and concrete piers, creating an honest design that embodies classic lines and stately proportions."



Cemetery Access Bridge, winner in Class III, was called "the most impressive entry in the competition." The jury said "The imaginative integration of the tapered legs and curving girder into one continuous rigid frame is at once graceful and exciting."

Rio Vista Bridge, winner in Class IV, was cited for its straightforward design. "In contrast with most lift bridges, its two towers are decorative as well as functional, providing stark contrast with the horizontal line established by the approaches."

This arch in the old railroad bridge will be removed soon and the area crossed by a single span to provide the channel for the new St. Anthony Falls Lock at Minneapolis seen under construction through the arch. The 50-ft lift lock will cost about $10 million; a total expenditure of $35 milllion is being made to provide navigation for an additional 3½ miles on the Mississippi. The lock construction and the St. Anthony Falls Hydraulic Laboratory of the University of Minnesota were points of interest for engineers attending the American Public Works Association convention.

Public Works Engineers Meet in Minneapolis

Problems of engineers attending the American Public Works Association meeting in Minneapolis in late September seemed to be on the political rather than the technical side. Public relations, financing, multiple areas of administration, duplication of services, inspection, were reported to need research. Unnatural boundaries for collection of wastes and the political problems of changing to a more logical basis were also given consideration in well attended sessions.

Equipment manufacturers showed a lot of new machines designed to solve the mechanical problems of keeping cities clean, sanitary, and free from snow. The exhibit covered two floors of the huge Minneapolis Auditorium. In size it ranged from hand-operated patch rollers to huge garbage-packer trucks and road-building machines.

At the meeting Albert G. Wyler, director of streets for New Orleans, was installed as president, succeeding F. W. Crane, F. ASCE, of the Buffalo, (N.Y.) Sewer Authority. The vice president is E. J. Booth, city engineer of Bismarck, N. D. New members of the board of directors are Lloyd D. Knapp, F. ASCE, commissioner of public works, Milwaukee, Wis.; John Lambie, county engineer, Los Angeles, Calif.; and Roy Morse, M. ASCE, city engineer, Seattle, Wash.

ASCE Director Harmer E. Davis, director of the Institute of Transportation and Traffic Engineering at the University of California, and chairman of the Highway Research Board, was made an honorary member of the APWA for "his outstanding record of leadership and achievement in the field of street and highway engineering, management and research and for his contributions to education."

In cooperation with Kiwanis International, APWA selected ten outstanding public works men of the year. These included ASCE Fellows Donald V. Auld, director of sanitary engineering for the District of Columbia; William A. Bugge, director of highways for the State of Washington; Jean L. Vincenz, director of public works for San Diego County (Calif.); and Alvin C. Welling, commanding general, Corps of Engineers Ballistic Missile Construction Office, Los Angeles.

Many speakers emphasized the importance of increased knowledge of the voters in getting their cooperation for needed works projects. Several told of success with group meetings in marshaling support; all emphasized the need for simple graphic presentation so the public will understand the problem and the reason for expenditures. It was brought out that public-works people themselves should make a determined effort for better representation on advanced planning of projects.

Research needs in public works were outlined by John Diederichs, of Armour Research Foundation, from replies to questionnaires to representative men in the field. Items highly recommended for applied research include: maintenance; selection, qualification, and development of personnel; how to organize a puplic-works department; cost estimating and budgeting practice; refuse processing. What can be done to improve the public image of public-works personnel, how to handle complaints, and how to talk convincingly about traffic—each needs solution.

In a discussion session headed by ASCE Director Samuel S. Baxter and E. J. Cleary, a question as to the need for cities in the future was voiced. Research on solar flight may result in the development of a self-sustaining environment of recycling water, growing foods, and the like that may eliminate much that holds a city together.

In the principal luncheon talk Rex M. Whitton, F. ASCE, Federal Highway Administrator, pointed out that one equipment manufacturer had spent $100 million in three years on research—about four times the amount spent on the AASHO Road Test. He pointed out that knowledge gained from such research is no good if it stays in the laboratories. It requires updating specifications or making special provision for use of the new ideas for construction, maintenance, and operation.

Who Wants to Study Abroad?

More than 115,000 individual opportunities for assistance with travel and study in 115 foreign countries are listed in the latest edition of UNESCO's *Study Abroad*. These scholarships and fellowships are offered by a total of 1,750 private organizations, governments, intergovernmental and international organizations including, for the first time, the International Atomic Energy Agency and the British Commonwealth Scholarship and Fellowship Plan. They are in all fields of study and research. Many more opportunities are available to American students than to those of other countries.

The comprehensive international handbook is available at $3.25 (including postage) from International Publications Service, 18 East 33rd Street, New York 16, N.Y.

Underground Power Plant For Oroville Dam Project

The California Department of Water Resources has retained the Bechtel Corporation, of San Francisco, to provide expert engineering advice on the design of the huge underground power plant that will be part of the Oroville Dam project. Oroville Dam will have an initial installed

capacity of 600,000 kw, with provision for later enlargement to 1,200,000 kw. The underground power plant will be located in an excavated chamber in the left abutment of the dam site. It will be similar in design to the Snowy Mountain underground plant in Australia, on which the Bechtel Corporation was engaged.

On the Oroville Project, Bechtel will assist the chief engineer of the Department of Water Resources on such aspects of design and construction as rock mechanics, layout and arrangement of equipment, and hydraulic design. Construction of the Oroville Project is scheduled to start next year.

Columbia Basin Repayment Controversy Settled

The Columbia Basin Project Board of Consultants submitted a report to the Secretary of the Interior in August, making recommendations toward solving the long-standing repayment controversy which has existed between the Bureau of Reclamation and Columbia Basin water users in the State of Washington. Basically, the Board of Consultants recommended sweeping changes in existing repayment contracts between the United States and three irrigation districts which would allow completion of the Columbia Basin Project to serve the 1,000,000 acres originally intended. Construction on the project, which secures its water supply from Grand Coulee Reservoir, has been virtually at a standstill for several years pending renegotiation of existing contracts.

The Board of Consultants recommended that the original construction-cost ceiling for the project be eliminated so that it can be completed, and that the unique restrictive provisions of the project be eliminated, allowing it to conform with other reclamation projects in the Western states. In addition, the Board recommended that the early-year repayment obligations of the water users be reduced, and that the repayment period be extended from 40 years to 50 years.

The three-man consulting board was headed by William R. Gianelli, F. ASCE, of the civil engineering consulting firm of Bookman, Edmonston and Gianelli, Sacramento, Calif. The other members were LaSelle Coles, president of the National Reclamation Association and manager of the Ochoco Irrigation District, Prineville, Ore., and Dr. Roy E. Huffman, Dean of Agriculture at Montana State University, Bozeman, Mont.

Steel Shipments Rise

During August the nation's steel mills shipped 6,139,418 tons of finished steel products—an increase over the 5,120,808 tons shipped during July and over August 1960 shipments of 5,071,593 tons. However, the 42,448,062 tons shipped in the first eight months of 1961 represent a considerable decline from the 52,633,983-ton total for the comparable period of 1960.

Major markets are warehouses and distributors (1,138,267 net tons); automotive (1,157,532 tons); and construction, including maintenance (972,447 tons).

U. S. Firm to Study Iranian Airports

To keep pace with the growing demands of world aviation, the Government of Iran has just appointed Frederic R. Harris, Inc., New York City consulting firm, to examine the nation's existing airport facilities and prepare a master plan for their development. The firm will head a joint venture with the Netherlands Airport Consulting Office and Ali Adibi and Associates of Iran.

In addition to uncovering deficiencies in existing facilities, the study will work out a plan for the improvement of each individual airport as required to meet estimated volumes of international, domestic, and military air traffic.

Largest Computer Center Dedicated

Groundbreaking ceremonies for the world's largest and most powerful electronic computing center took place at Cambridge, Mass., on October 9. Dr. Herbert W. Robinson, president of C-E-I-R, Inc., the industrial and electronic-data processing firm that will install and operate the $15,000,000 facility, turned a spadeful of earth for 545 Technology Square—the first building of an industrial and scientific research complex being developed jointly by the Massachusetts Institute of Technology Corporation and Cabot, Cabot & Forbes Company. Among other participants in the ceremony were John A. Volpe, governor of Massachusetts, and Dr. James R. Killian, Jr., chairman of the M.I.T. Corporation.

Equipped with a giant new STRETCH computer and with four additional IBM's, the center will provide versatile computer service for the entire eastern half of the country as well as for the Boston-Cambridge area. It will be available to business and industrial organizations, in addition to academic, government, scientific, and military users. The new facility is expected to be in full operation by 1963.

U.S. Hydraulics Laboratory Directors Tour Soviet Labs

Five U.S. hydraulics laboratory directors, all Fellows ASCE, have just returned from a two-week tour of laboratories in Russia, and during the winter a group of Soviet hydraulicians will visit the American institutions represented by the delegation. Making the trip were Harold M. Martin, of the Bureau of Reclamation, Denver; Prof. Arthur T. Ippen, Massachusetts Institute of Technology, Cambridge; Prof. Hunter Rouse, State University of Iowa, Iowa City, who organized the exchange; Prof. Lorenz G. Straub, of the University of Minnesota, Minneapolis; and Joseph B. Tiffany, of the U.S. Waterways Experiment Station, Vicksburg.

Institutions visited were the hydraulics laboratory of Hydroprojects, Moscow; the Wave Science Research Center, Sochi; the All-Union Hydrotechnical Research Institute, Leningrad; the Leningrad Institute of Water Transport; and the Leningrad Hydrologic Institute.

In this view, taken before the Hydrotechnical Research Institute, Messrs. Martin and Tiffany are third and sixth from the left; Professor Rouse is at the center, Professor Straub directly behind him, and Professor Ippen to the right. Prof. B. V. Proskuriakov, director of the Institute, is fifth from the right. M. F. Skladnev, deputy director in charge of coordination of hydraulic research works in the USSR, who will head the Soviet delegation to the U.S., is fifth from the left.

Prefabricated Fallout Shelter for Family Use

Patented, prefabricated steel and concrete family fallout shelter will be marketed by the Empire National Corporation and its affiliate, Coraloc Industries, Inc. Manufactured for Coraloc by the American Bridge Division of U.S. Steel, the new, six-person shelter has been approved for design by Civil Defense headquarters at Battle Creek, Mich. The 10-ft-dia shelter is packaged in a kit that includes waterproof steel sidewalls, supports, exhaust vent, filter screen, air pump, entry way, and emergency exit. A patented interlocking principle employed in the sidewalls completely resists changing earth pressures, preventing damage caused by cycles of freezing and thawing.

EXAM GEMS

by Reggie Straslu

R. ROBINSON ROWE, F. ASCE

EXAMGEM 28, like its predecessor, required the writing of definitions of engineering terms. Tasks of this sort are quite common, but a poor measure of competence if the answers can be copied from well-indexed permissible texts. In this case the 12 terms had been carefully selected. Although all were in common usage, most were fairly new at the time (which dates the problem). Also, the distribution of the terms among the special fields of civil engineering had apparently been calculated to reward students of current engineering journals who kept abreast of progress in other fields than their own specialties.

From an analysis of the answers for any particular term, 15 percent had a fairly precise understanding of its meaning, 40 percent had a general understanding, and 45 percent none at all. These groups were sharply defined, except that "general understanding" varied considerably in degree. Among individuals, fewer than 5 percent had creditable knowledge of all 12 terms, but 60 percent had enough understanding of 9 terms to have achieved a passing grade if they had been able to express themselves clearly.

We can learn from the dry statistics that many professional engineers read their journals extensively, but that too many lack thoroughness, retentiveness, or resourcefulness to report an essential element encountered in their reading.

For example, one of the 12 terms was "constant radius," and the requirement was to define it in terms of its application to engineering practice. Here are some of the answers:

a. Constant radius is a circle.

b. Constant radius is a highway curve without spiral easements.

c. Constant radius is the circular shape of a dam.

All three are guilty of the commonest mistake in writing definitions—a mistake known as the crime of involuntary synecdoche. Constant radius is not a circle, or a curve, or a shape, but a characteristic or element of each. Remember on examinations, don't synecdochematize.

Mr. A gave no application and could have said the same of a cylinder or a sphere; obviously he didn't recognize the expression as an engineering term. Neither did Mr. B, although he did connect it with an elementary application. Each of them is behind in his outside reading.

Mr. C deserves a special scolding: he connected the term with an application, but too vaguely to prove an understanding. He could have used the same definition for "constant angle." Probably he knew the dam was an arch; why didn't he say so? Did he know the radius was a constant for all horizontal sections? Or whether it was constant for face or axis? These factors were essential to the definition. Remember a definition, by definition, is concise and precise.

Some of the serio-comic guesses at the meaning of other terms would make light reading if space permitted, one of the most pathetic being, "Consumptive use is part-time outdoor easy jobs for arrested tubercular patients."

Contributing also to the gem quality of the task was its second part asking the examinee to select one of the terms and describe its engineering application in more detail. Practically all found a familiar term on which they had sufficient knowledge, but few succeeded in conveying that knowledge with clarity and coherence. Those preparing for examinations should include practice in technical writing, and by practice we mean practice, Practice, PRACTICE.

EXAMGEM 29

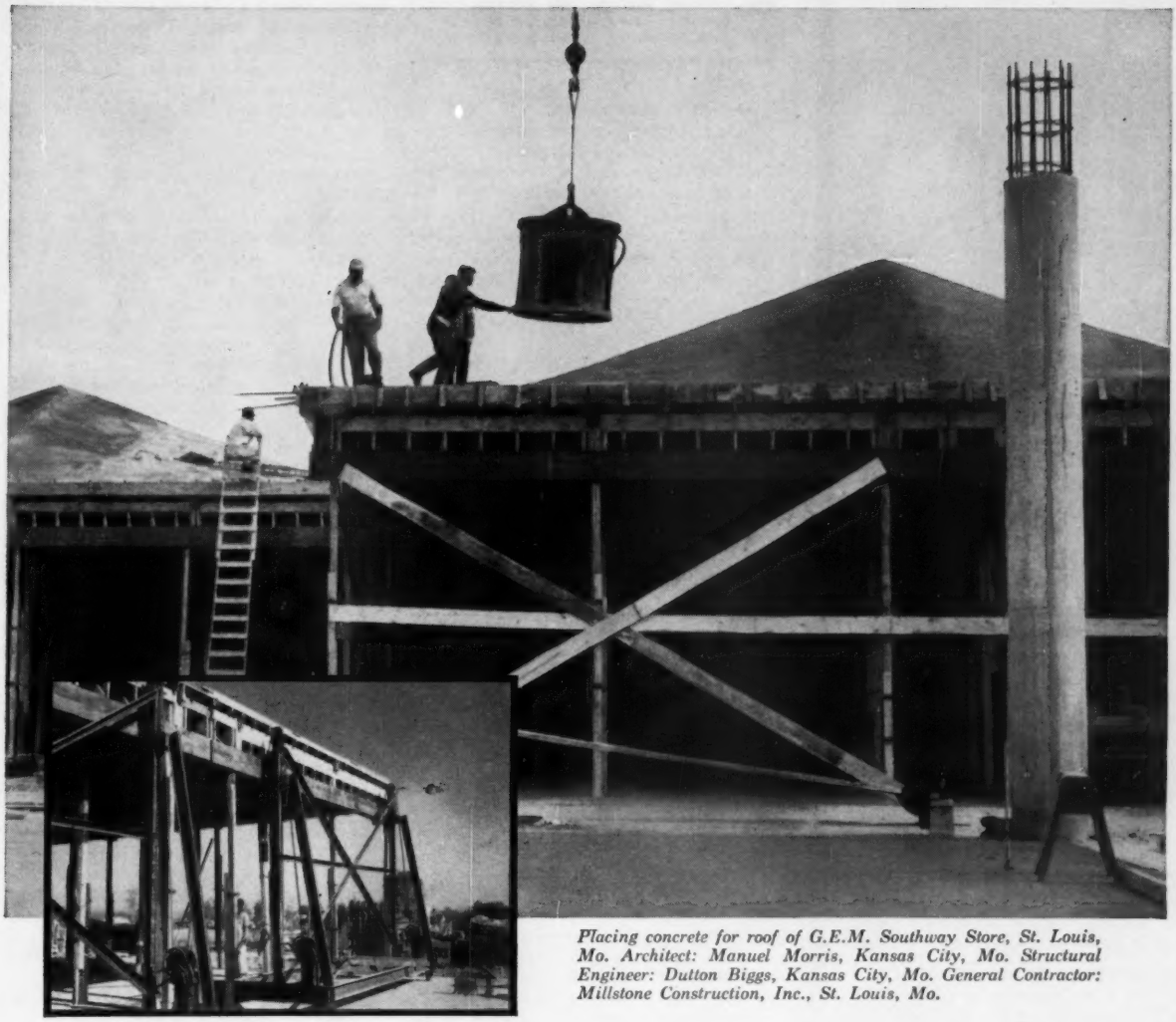
A correspondent asks for a solution to the following problem (Idaho, 1957) and others may also be interested in a "least-work" procedure:

A rectangular flume discharging at a depth of 5 ft, width of 20 ft, and slope of 0.00147 is converted to a measuring device by construction therein of a suppressed weir 2.45 ft high. Taking the weir coefficient at 3.45 and Manning's n at 0.025, compute approximate depths for the same discharge 10 ft and 1,000 ft upstream from the weir.

ASF Expands Its Research Program

The Automotive Safety Foundation will expand its highway research program to help states plan their future highway construction. The first project under the new program will be a study for the State of Washington to develop procedures for scheduling highway improvements on a priority basis, with construction geared to revenues available under the state's existing tax structure. The year-long study will be made at the request of the State Highway Commission and the Washington Legislative Joint Fact-Finding Committee on Highways, Streets and Bridges.

Research to determine the relationship of highway design to accidents will be included in the program. ASF engineers are now working with the U.S. Bureau of Public Roads in a joint project to collect information on accidents in which highway design could have been a contributing factor.



Placing concrete for roof of G.E.M. Southway Store, St. Louis, Mo. Architect: Manuel Morris, Kansas City, Mo. Structural Engineer: Dutton Biggs, Kansas City, Mo. General Contractor: Millstone Construction, Inc., St. Louis, Mo.

Special lifting device raising formwork

Only 6 weeks needed to roof 120,000 sq. ft. store with concrete hyperbolic paraboloids

In the building of the new G.E.M. Southway Department Store, St. Louis, doors opened for business just 85 working days after award of the construction contract. A major reason for the record-time completion of this one-story, one-area shopping center lay in the concrete shell roof.

The roof is composed of 50 reinforced concrete hyperbolic paraboloids. Each of these umbrella-shaped shells is supported by a 24-inch diameter concrete column. Through the efficient re-use of only 5 sets of forms, sizable savings in both time and labor were effected. All 50 shells, each 47½ ft. square and 2½ inches thick, were completed within 6 weeks.

Construction of the hyperbolic paraboloids was done in rows. Thus, masonry, plastering and other trades began work as soon as a row was completed.

This is another good example of the way improved techniques have made shell roof designs economically practical for structures of all types and sizes. No wonder structurally strong concrete is the choice of more and more engineers and builders! Write for technical facts. (Free in U.S. and Canada only.)

PORTLAND CEMENT ASSOCIATION
Dept. A11-13, 33 W. Grand Ave., Chicago 10, Illinois

FOR STRUCTURES... MODERN **concrete**

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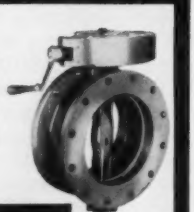

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DECEASED

Robert L. Bannerman (A.M. '24; M. '59), age 68, until recently district manager for the Mexican Petroleum Corporation at Tallahassee, Fla., first joined the firm as sales engineer back in 1937. He had previously served with the Florida State Road Department as resident engineer, district engineer, and then division engineer. For a seven-year period in the 1930's he had also been a partner in the consulting firm of Cresup and Bannerman.

John R. Blondin (A.M. '34; M. '59), age 59, a civil engineer with Moran, Proctor, Mueser and Rutledge of New York, had been an on-the-job representative of the firm on the Puget Sound Naval Shipyard supercarrier drydock in Bremerton. At one time he was assistant engineer with Modjeski, Masters & Chase and worked on the Mississippi River Bridge in New Orleans, La., for that firm.

Leonard F. Boon (A.M. '40; M. '59), age 81, when he died recently was assistant professor emeritus at the University of Minnesota. He first joined the University's engineering staff as an instructor in 1921, and from 1924 until 1948 was an assistant professor there.

Donald Merton Elliott (J.M. '49; A.M. '59), age 34, having graduated from the University of California in 1949, almost immediately joined Electrical Constructors as an engineer in Columbus, Ohio. He was still with the firm serving as project engineer in Dallas, Texas, when he died in an accident recently.

Edward M. Knapik (M. '35; F. '59), age 63, was a well-known San Francisco consulting engineer and a partner in Huber & Knapik. He played a leading role in the design of numerous major Bay area projects, among which were the University of California's Bevatron and Radiation Laboratory, Moffitt Hospital, and several other buildings of the UC Medical Center.

E. F. Laflin (A.M. '49; M. '59), age 48, since 1951 had been an engineer in the San Francisco, Calif., firm of Sverdrup & Parcel, Inc. Prior to joining Sverdrup & Parcel, he worked briefly as an engineer-inspector for International Bechtel, Inc., in Saudi, Arabia. This had been preceded by several years each as senior engineering aide and assistant highway engineer with the California Division of Highways and as structural designer detailer with D. R. Warren and Company.

George K. Larrison (M. '15; F. '59), age 85, had been a consulting and hydraulic engineer in Honolulu, Hawaii, since retiring in 1940 as representative of the Hawaiian Homes Commission of the U.S. Department of the Interior. Professionally, Mr. Larrison's experience falls into two periods—his experience in the Philippine Islands where he served first as assistant engineer with the Bureau of Engineering in Manila and then as assistant engineer and principal assistant to the chief irrigation engineer in the Bureau of Public Works; and the work he did with the U.S. Geological Survey in Hawaii as assistant engineer and district engineer for the Water Resources Board, as superintendent of hydrography, and as chief construction engineer and senior hydraulic engineer with the Board of Water Supply. Mr. Larrison had retired from the U.S. Army some years ago with the rank of Colonel.

Percy R. Leete (A.M. '11; M. '59), age 78, for several years past retired, had previously served as assistant engineer in the Valuation department of the New York, New Haven, and Hartford Railroad at headquarters in Boston, Mass. His association with the railroad dates back to 1904 when he joined as instrumentman, becoming in order chief of party, general assistant and resident engineer.

Walter L. Lowry, Jr. (M. '49; F. '59), age 54, just this year had been named dean of the Clemson College School of Engineering. Before joining the Clemson faculty in 1949 as associate professor of civil engineering, he taught for several years at Virginia Military Institute and at Richmond Polytechnic Institute. Considered an expert on prestressed concrete, Mr. Lowry also had been employed as engineer in charge of construction by the Deering Milliken Corporation.

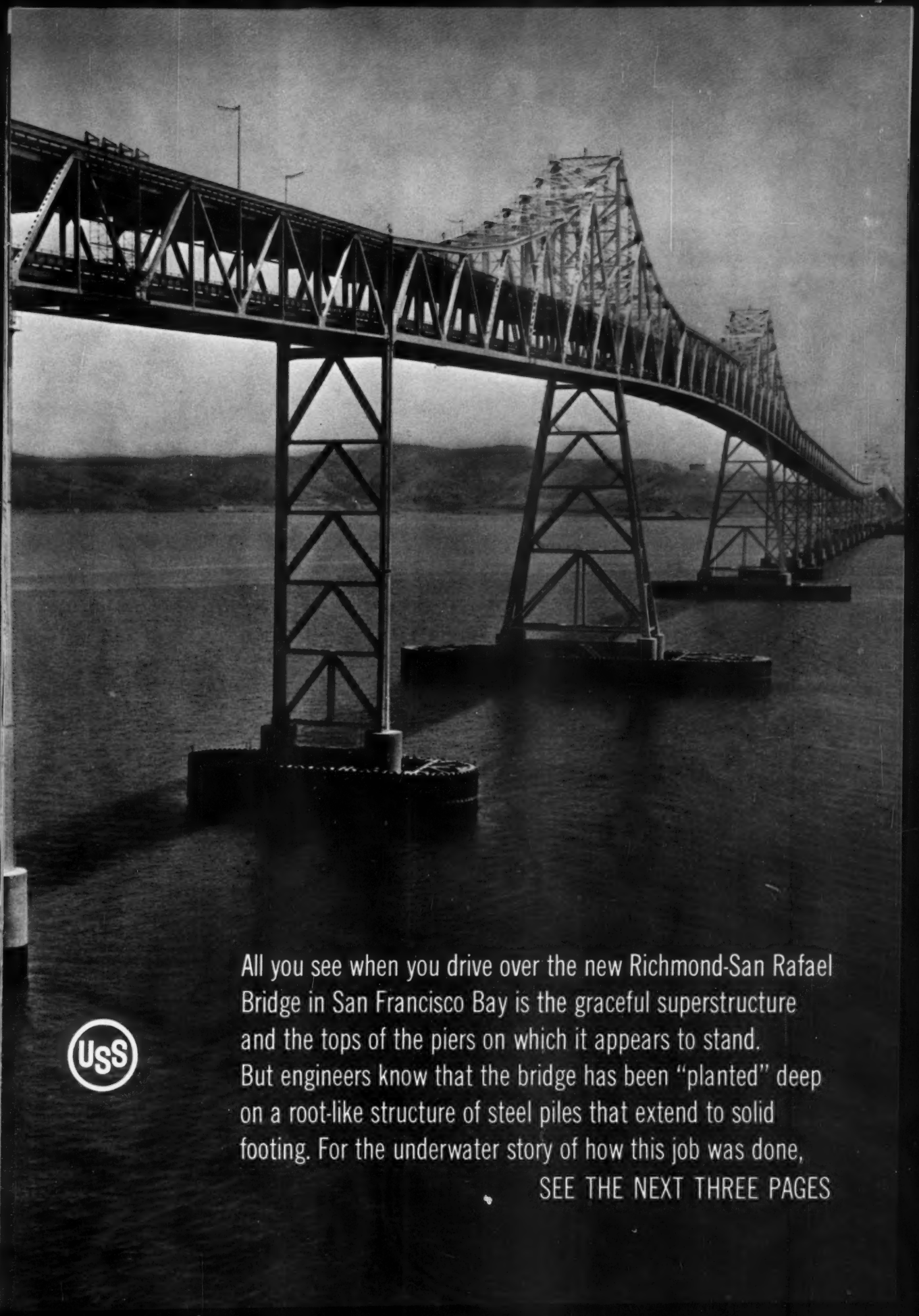
Albert M. McPherson (M. '32; F. '59), age 77, during his entire career engaged in engineering in western United States, for the past 35 years as a consultant with offices in Wichita Falls, Texas. Earlier, he was general superintendent of the Utah Project for the Delta Land and Water Company, president and general manager of the Delta Canal Company, and president of the Western Engineering Corporation.

Pat Murphy (J.M. '50; A.M. '59), age 32, since 1960 had been employed as a structural engineer by the Empire Prestressed Concrete Products Company. Prior to that time he had been employed by the Oregon State Highway Department on bridge design and electronic computer programming and by Moffatt, Nichol & Taylor as a structural engineer. He held a B.S. degree in civil engineering from Santa Clara University (1950) and after making some specialized studies in prestressed concrete an M.S. degree from the University of Illinois (1957).

Warren R. Neel (M. '19; F. '59), age 78, was one of the founders and a longtime chief engineer for the Georgia State Highway Department. When the department was in its third year in 1919 he became its engineer, serving in that capacity until 1930. Thereafter, for many years he was associated with government construction, returning to Atlanta after World War II to head the state highway Department again as its chief engineer.

Charles E. Pett (A.M. '15; M. '59), age 80, in 1902 received his B.S. degree

(Continued on page 101)

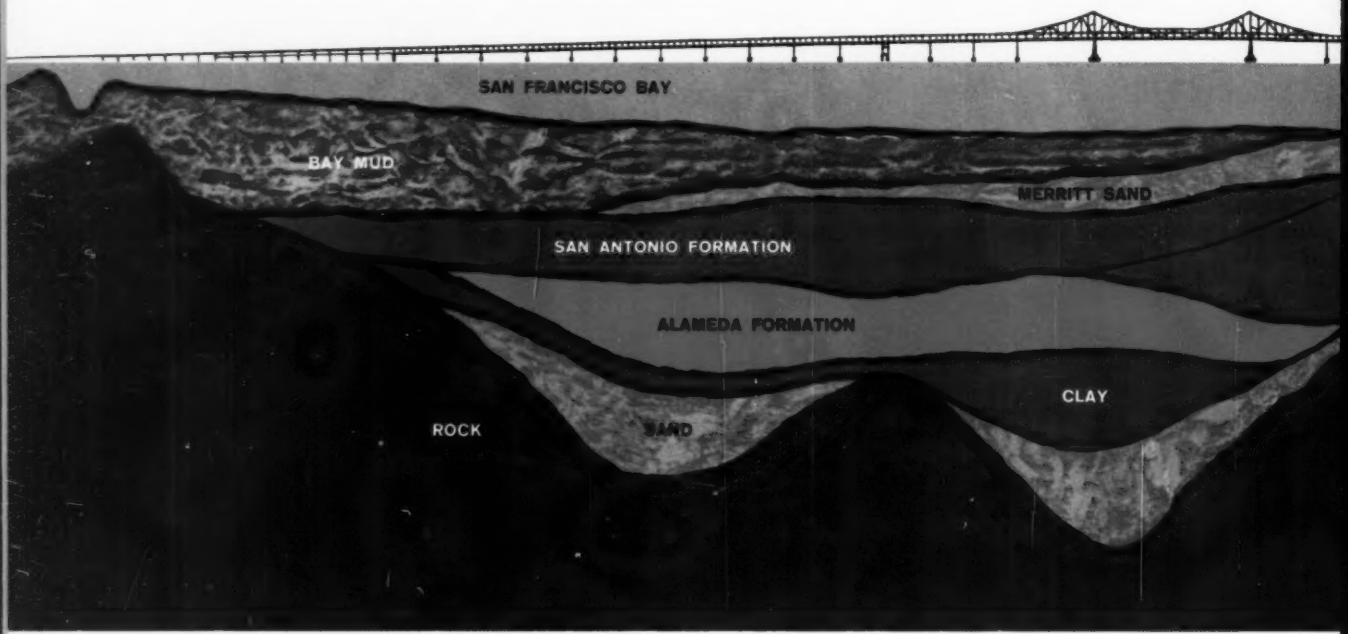


All you see when you drive over the new Richmond-San Rafael Bridge in San Francisco Bay is the graceful superstructure and the tops of the piers on which it appears to stand. But engineers know that the bridge has been "planted" deep on a root-like structure of steel piles that extend to solid footing. For the underwater story of how this job was done,

SEE THE NEXT THREE PAGES

USS

Richmond-San Rafael Bridge over San Francisco Bay—length 21,345 feet. Lower sketch shows stratification encountered and points up need for extra long piles. This bridge was built for the State of California, Department of Public Works, Division of San Francisco Bay Toll Crossings. Substructure General Contractor: Ben C. Gerwick, Inc., and Peter Kiewit Sons Company.



Problem: How to put the Richmond-
Solution: (USS) H-Piles under novel

The Richmond-San Rafael Bridge, just north of San Francisco, is one of the world's longest. It stretches across the bay for 21,345 feet. This makes it longer than the Mackinac Bridge and only 1,377 feet shorter than the San Francisco-Oakland Bay Bridge. The new bridge has two decks, each carrying three lanes of traffic across San Francisco Bay between Richmond and San Rafael, California.

Tests on soil samples indicated proposed loads on displacement-type piles would probably result in excessive settlement. It was decided that piles had to be driven to rock or into a deep sand-gravel stratum.

Studies indicated that steel H-piles were the logical choice because:

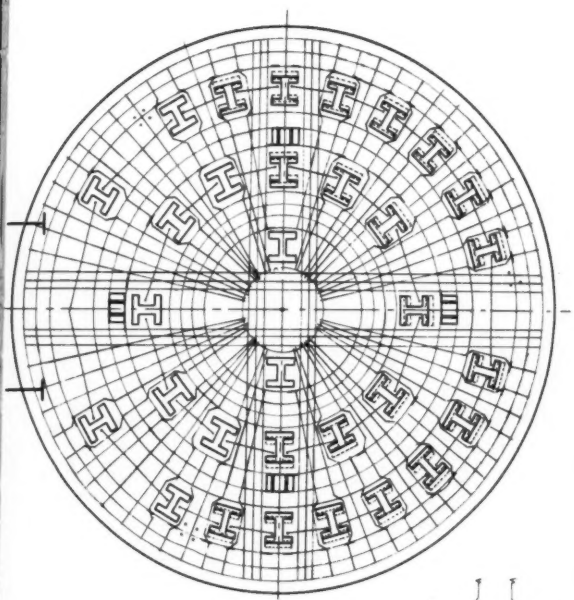
1. H-piles were more suitable for penetrating the deep overburden in order to reach suitable strata for end bearing.
2. H-piles provided utmost flexibility of final lengths—they could be easily cut or spliced.
3. Their ruggedness made for easy handling.
4. Their strength permitted heavy loads per pile.
5. They were readily available.

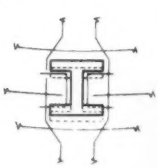
Precast bell-type piers were selected for the deep water portion of the job. These had proved economical for pile-supported piers in moderately deep water on previous major bridge jobs. At each bell-pier location, several steel H-piles were driven to position a precast concrete base grid which was later incorporated in the pier foundation. The base grid contained slots designed to act as guides for the remaining 14-inch, 89-pound steel H-piles. These were later grouted into the base grid which then served as the base for the precast bell sections set on top. After pouring a tremie seal inside the bells, the rest of the concrete was placed in the dry. These base grids were 12 to 56 feet below water so that the contractor had to provide for underwater driving of piles. This was done with rigs especially designed for the job to provide telescoping leads to support the hammer as deep as 56 feet under water and the pile head as much as 110 feet above the water.

There were 62 bell-type piers constructed. In addition, 8 cofferdam-type piers and 9 dry-land piers also utilized steel H-piles. The 79 piers are supported by 5,047 14-inch, 89-pound steel H-piles ranging in length from 30 to 175 feet—a total of 585,700 lineal feet, or about 25,000 tons, approximately half of which were supplied by United States Steel.

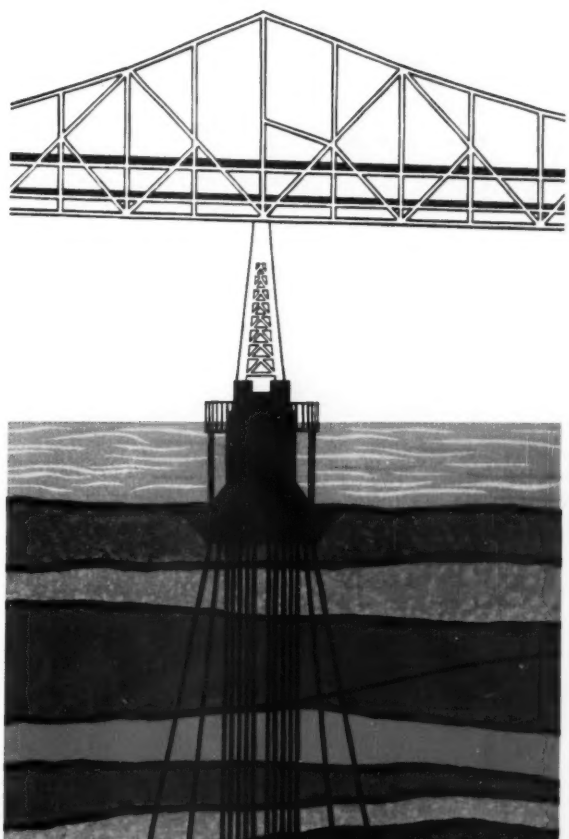
For information on any type of steel piling—steel H-piles, sheet piling or steel pipe piling, write to any of our district offices or United States Steel, 525 William Penn Place, Pittsburgh 30, Pennsylvania.

San Rafael Bridge across these holes... bell-type piers





Base grid for bell-type pier showing slots for locating piling. Batter piles indicated by dotted lines and shown in detail on small drawing.



TURN PAGE

how the bell-type piers were constructed underwater

1. At each pier location, concrete base grids containing slots to guide the steel H-piles were lowered through the water to exact position. Some were as deep as 56 feet.

2. Several steel H-piles were driven to hold each base grid in exact position. The remaining piles were then driven and the base grids were later incorporated in the pier foundation. Where necessary, pile tops were cut off underwater by divers.

3. Cylindrical precast bell sections were lowered through the water and positioned on top of each base grid. A special seal made the joints watertight.

4. Cone-shaped precast concrete or steel sections with a seal on top and bottom were then placed on top of the cylindrical sections.

5. Precast shaft extending above water. After pouring a tremie concrete seal inside the bells, the rest of the concrete was placed in the dry.

For the main piers using four interconnected bells and for some of the two-bell piers, special steel forms were used instead of precast concrete bells.

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from Rutgers College and in 1905 joined Post & McCord, Inc., steel fabricators and erectors of New York City, where he remained until his death recently. He served in various capacities, concluding his career as vice president.

Herbert M. Rouse (A.M. '16; M. '59), age 75, retired in 1953, after a long and vigorous career as an irrigation engineer. Over the years he served with the California Development Company as superintendent of its Valley and River divisions, with the Imperial Irrigation District as an irrigation engineer, the Colorado River Land Company as chief engineer, and as consulting civil engineer, all the while remaining in Calexico, Calif.

Sabri Sami (M. '58; F. '59), age 42, for the past three years was professor of civil engineering at West Virginia University, having previously taught at Lehigh University, the University of Missouri and the University of Auburn. Prominent in the field of structural engineering, Professor Sami, in addition to industrial experience with Parsons, Brinckerhoff, Hall and Macdonald and Howard, Needles, Tammen and Bergendoff, recently did research work as a consultant at the Naval Civil Engineering Laboratory at Port Hueneme, Calif.

Bruce Short (M. '52; F. '59), age 75, who joined Hugh J. Baker and Company as long ago as 1925, had since served as sales engineer and manager of the highway department, and most recently as department head. He was also for a time during the mid-1950's secretary-treasurer of the Indiana Toll Road Commission in Indianapolis.

Stephen W. Waterman (M. '59; F. '59), age 38, worked in various capacities with the Foster Wheeler Corporation of New York City. He began as structural designer, was promoted to assistant section head of the Heat Recovery Section, then to section head of the Nuclear Engineering Section, and most recently to structural engineer in the Contract Engineering Equipment Division where he was a consultant on civil engineering problems.

Ellwood C. Wilder (M. '22; F. '59), age 75, of Honolulu, Hawaii, retired in 1947. From 1911 until 1920 he engaged in various government work, and from the latter year until his retirement served with the City and County of Honolulu, first as an engineer in the Water and Sewer Department and later as an engineer in the Division of Sewers.

Phillip G. Young (A.M. '35; M. '59), age 57, county engineer and surveyor for Refugio County in Texas was also a former city engineer of Refugio. He joined John B. Hawley in 1925, remaining with the organization during subsequent changes. In 1930 when the firm became Hawley, Freese and Nichols, Mr. Young as resident engineer worked on the construction of a water storage reservoir and dam for Corpus Christi and on water works, sewerage system and a sewage disposal plant for Refugio.

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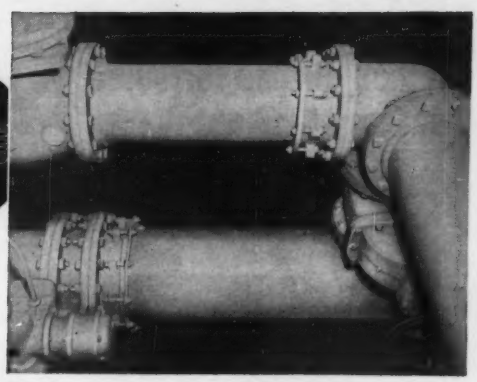

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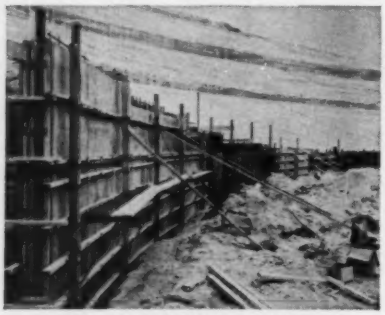

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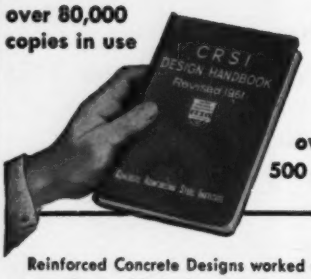

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Introduction au Calcul et a l'Execution des Voiles Minces en Beton Arme

A concise treatment of the theory and design of thin shells of reinforced concrete, covering cylindrical shells, shells of double curvature, and prismatic structures. There are also brief notes on construction methods, cable-supported roofs, buckling instability, and the value of prestressing. (By André Paduart. Editions Eyrolles, Paris, France, 1961. 95 pp., bound. NF 18.75.)

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Practical Design of Structural Members

Tables, charts, and diagrams, supplemented by analyses and discussions, are presented with a view to eliminating involved formulas and tedious calculations and to reducing design costs. The topics covered include stress analysis, reinforced concrete, foundations and footings, retaining walls, masonry, structural steel, beams, plate girders, columns, rivets and connections, roof trusses, wind stresses, steel joists, wood, rigid frames, and earthquake resistance. Changes in the present edition reflect the changes in the American Concrete Institute Code of 1956. (By Thomas A. Lucy. F. W. Dodge Corporation, 119 West 40th Street, New York 18, N. Y., 1961. Various pagings, bound. $12.00).

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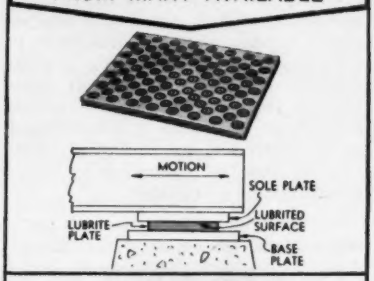

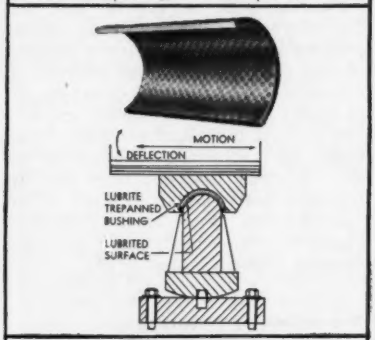

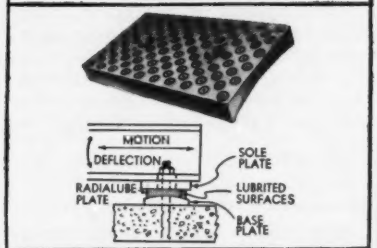

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Shielding Materials for Nuclear Reactors

The results of Russian investigations into practical methods for constructing radiation shielding for nuclear reactors and accelerators are presented. Full details are provided on the different types of concrete which have been used, together with their properties and strength. Particular attention is paid to heavy and hydraulic concretes, and information is given on variation in attenuation which results from varying the type of concrete. (By A. N. Komarovskii. Pergamon Press, Inc., 122 East 55th Street, New York 22, N. Y., 1961. 145 pp., bound. $9.50.)

Structural Engineering for Professional Engineers' Examinations

This book is intended to facilitate preparation for the structural and civil engineering sections of the professional engineers' examinations given throughout the United States. The material presented is based on questions and problems that have appeared on actual examinations, and covers such areas as torsional stresses, roof and bridge trusses, timber design, soil mechanics, reinforced concrete columns and beams, hydraulics, surveying and route design, and water supply and sewage. In addition the author presents various direct methods of designing structural members, provides simple methods of solving surveying problems that require construction of a parabolic arc, and shows how engineering calculations can be tested for accuracy as the work progresses. (By Max Kurtz. McGraw-Hill Book Company, Inc., 330 West 42nd Street, New York 36, N.Y., 1961. 348 pp., bound. $9.00.)

Theory of Elasticity

Starting with the basic concepts of strains and stresses, the author develops a completely general method of approach to any problem in the theory of elasticity. He then shows how the general equations can, with certain conditions, be modified to the more familiar linear equations. Several useful applications of the theory to the solution of specific problems such as stress concentration, torsion, and simple bending and shear are illustrated. Translated from Russian. (By V. V. Novozhilov. Pergamon Press, 122 East 55th Street, New York 22, N. Y., 1961. 448 pp., bound. $12.50.)

Theory of Traffic Flow

The papers in this volume treat aspects of traffic flow theory ranging from the control of traffic by means of special signal systems to the analysis of traffic flow using statistical theories and models. Other subjects covered are the design of communication and transportation networks, single lane traffic theory and experiment, distribution of traffic on a road system, and single-line traffic flow in tunnels. (By Robert Herman. D. Van Nostrand Company, 120 Alexander Street, Princeton, N. J., 1961. 238 pp., bound. $8.75.)

Water Supply and Waste Disposal

Insofar as possible an integrated treatment is given of fundamental principles and practices in the field. This is followed by a detailed description of both the design and operation of systems for water supply and for waste disposal. A broad view of the subject is taken by the authors who consider such problems as the growing populations coupled with rapid suburban development, the steadily increasing per capita rate of water use, and the increasing quantity of industrial waste products. (By W. A. Hardenbergh and Edward R. Rodie. International Textbook Company, Scranton, Pa., 1961. 503 pp., bound. $11.00.)

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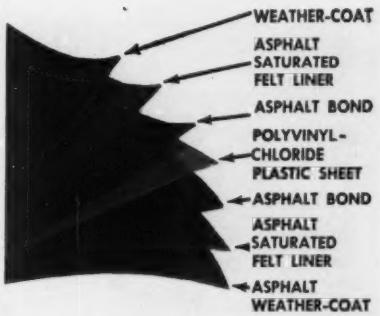

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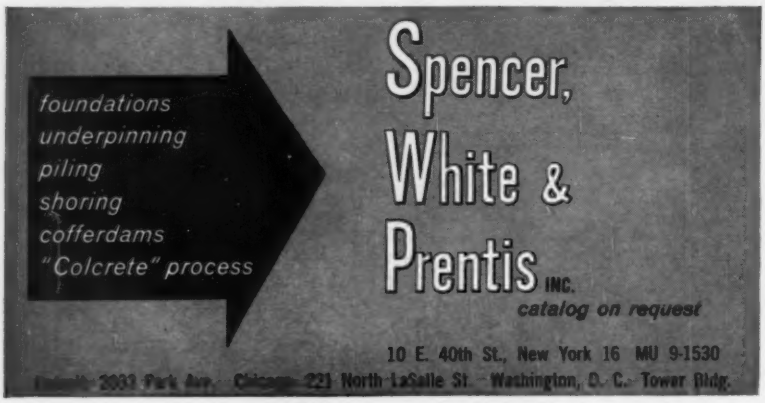
New in education

Graduate programs . . . . . .

A new graduate program in engineering geology and groundwater has been established at *Cornell University* under the guidance of Professor George A. Kiersch, F.ASCE. Centered in the Department of Geology, the geological courses are combined with those of allied departments in the College of Arts and Sciences and integrated with supporting courses offered as a minor in one of three other Colleges—Engineering, Agriculture, or Architecture—according to the candidate's specialized interests. This program provides opportunity for well-rounded training in geology with a minor in a science or engineering specialty such as soil science or soil mechanics, foundation engineering, hydraulics and hydrology, photogrammetry and aerial-photo interpretation, water supply, agronomy, agricultural engineering, or regional planning and development. The first students under the program are currently enrolled at both the Masters and Doctorate levels. Several research projects in the fields of engineering geology and groundwater have been initiated on the basis of grants-in-aid already received.

A graduate program in radiological health control is being conducted at *Rensselaer Polytechnic Institute* under a $137,500 grant from the U.S. Department of Health, Education and Welfare. Starting last September 1 the program will run for five years. As outlined by Professor Edward J. Kilcawley, F.ASCE, who will direct it as chairman of environmental engineering in the Department of Civil Engineering, the program will investigate the engineering controls necessary in radiation work. These include methods for prevention of contamination at the source and for control of effects resulting from both normal and accidental concentrations of radiation.



Sears-Roebuck fellowships . . . . . .

For the sixth consecutive year, the *Sears-Roebuck Foundation* will award two-year graduate fellowships in the field of city planning and urban renewal. A minimum of ten fellowships—each one up to $3,000 a year to the student and $1,000 a year to the school where the Foundation fellow studies—will be awarded for the 1962-1963 academic year. For information and applications write to the Sears-Roebuck Foundation, c/o City Planning Fellowship Program, 3333 Arthington Street, Chicago 7, Ill.

New engineering curriculum . . . . . .

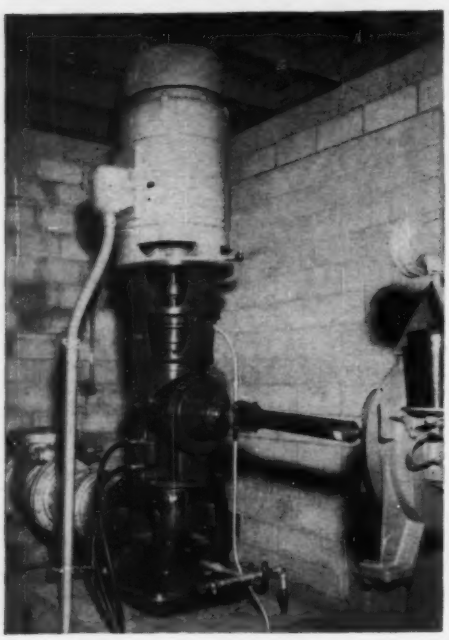
In September 1961, the *California State Polytechnic College* at Pomona introduced a civil engineering curriculum. For information, contact Forest E. Blair, Assistant Professor, Civil Engineering Department, Kellogg-Voorhis Campus, Pomona.

Do you want to teach engineering? . . . . .

The *Illinois Institute of Technology* has been awarded a Ford Foundation grant of $50,000 for a program to encourage highly qualified individuals into faculty careers in engineering. The loans, to be awarded to present or potential doctoral students who wish to enter engineering faculty careers but who have financial needs that prevent them from completing their courses, will be granted over a period of three years to any one applicant, the total of which shall not exceed $10,000. It will be forgiven at the rate of $1,000 per year for service on an engineering faculty in the United States or Canada, but if the recipient does not so serve the loan is repayable at the rate of $100 per year.

Basic research . . . . . .

An adhesive epoxy resin—stronger than steel studs when used to bond bridges and buildings together—may become a leading



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product in the construction world of tomorrow, according to Dr. Gene M. Nordby, M. ASCE, head of the *University of Arizona's Department of Civil Engineering* and director of the adhesives research program. A $24,000 grant from the Arizona Highway Department and the U.S. Bureau of Public Roads initiated adhesive research at the university two years ago and additional support has been forthcoming from the committee on adhesives of the American Concrete Institute. The university will soon augment the program with Switzerland-designed equipment to test full-scale structures, the first of its kind to be installed in an American university.

In addition *University of Arizona* civil engineers, Dr. Robert Schmidt and Dr. Gerald A. Wempner, are conducting basic research on the behavior of "sandwich shells"—strong, lightweight panels consisting of layers of different materials of types used in missile and aircraft construction—in an effort to establish general, simplified equations which would provide the basis for subsequent solutions to a variety of practical and important problems of structural design in the space age. The two year project is supported by a $37,500 National Science Foundation research grant.

Fellowship in fluid mechanics . . . . . .

A Boris A. Bakhmeteff Research Fellowship in an amount up to $3,000 will be available for the 1962-1963 academic year for a definite research project of original and creative nature in the general field of mechanics of fluids. The fellowship, offered by *Humanities Fund, Inc.*, is intended for a graduate student who does not hold any other fellowship or major income-producing commitment that will interfere with his research work and study on a full-time basis. Although the study and research may be undertaken at an institution of the Fellow's choice, the adequacy of the facilities will have substantial weight in the selection. Application forms should be filed by February 15, 1962 with Dean William Allan, School of Technology, City College of New York, New York 31, N. Y.

Non-ASCE Meetings

American Institute of Planners. National conference at the Statler Hilton Hotel, Detroit, Mich., November 26-30, 1961.

American Institute of Steel Construction. Thirty-ninth annual meeting at the Boca Raton Hotel and Club, Boca Raton, Fla., November 27-30, 1961.

American Society of Mechanical Engineers. Annual meeting at the Statler Hilton Hotel, New York, N. Y., November 26-December 1, 1961.

Associated Equipment Distributors. Forty-third annual meeting at the Hilton Hotel, Chicago, Ill., January 28-February 1, 1962.

Purdue University. Conference on structural welding for engineers and architects on the Purdue campus, Lafayette, Ind., November 30 and December 1, 1961. Conference is being held in cooperation with the Indiana Steel Fabricator's Association.

University of Florida. Conference on highway engineering being held on the University's campus in Gainesville, November 9 and 10. For additional information contact W. H. Zimpfer, Highway Engineering Conference Chairman, University of Florida, Gainesville, Fla.

University of Wisconsin. Conference on soil mechanics and foundations will be presented by the University's Extension Division on the campus in Madison, Wis., December 14 and 15, 1961.

Washington State University. Conference on Western Tidal Hydraulic Problems on the campus at Pullman, Wash., November 30 and December 1, 1961.

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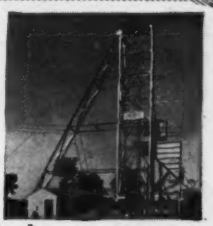

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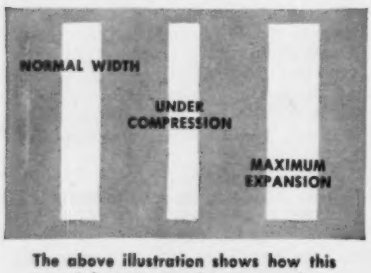

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Applications for Admission to ASCE, September 2-30, 1961

Applying for Associate Member

Ertan Riza Acaroglu, Ankara, Turkey
Hiroyuki Aoyama, Washington, D.C.
Suresh Chander Arya, Cleveland, Ohio
Juan Azpurua, Caracas, Venezuela
Jacques Michel Henry Baron, Paris, France
William Baron, Lafayette, Ind.
William Edward Barton, Bethlehem, Pa.
Richard Harry Burns, Latham, N.Y.
Joseph Page Colley, Redlands, Calif.
Anton De Kok, Lansing, Mich.
William Christopher Finneran, Jr., New York, N.Y.
Hans-Joachim Fritz Otto Arthur Foerstel, Port Arthur, Canada
Ralph Edward Gaines, Portland, Ore.
Henning Wiby Jakobsen, Salina, Kans.
Herbert Jarbath, Port-au-Prince, Haiti
Christopher David Kennedy, London, England
Raymond Kurjian, Ontario, Canada
Eleusipo Labrada Crecente, La Habana, Cuba
James Lawrence McCarty, Toledo, Ohio
Jaime Leon Mendoza Sanchez, Caracas, Venezuela
Kenneth James Nixt, Los Angeles, Calif.
Thomas Peter O'Connor, St. Paul, Minn.
Ogba Ihendu Ogba, Lagos, Nigeria
William Michael Perpich, Lafayette, Ind.
William Sloan Phelan, New York, N.Y.
James Arthur Porter, Frankfort, Ky.
Robert Charles Ready, Ithaca, N.Y.
James Curtis Reynolds, Richmond, Calif.
Donald Noah Rothblatt, New York, N.Y.
Walter Ray Schellhase, New Orleans, La.
Donald Ray Smail, Helena, Mont.
Ted Allen Smith, Sacramento, Calif.
Herbert Stewart Starrett, Los Angeles, Calif.
Vasant Hargovindas Surti, Lansing, Mich.
Mark Gail Symons, Adelaide, Australia
Leon Ru-Liang Wang, Cambridge, Mass.
Tin Win, Rangoon, Burma
Gordon Leimbach Woelper, Baltimore, Md.
Edward Jardine Wortman, Berkeley, Calif.
Charles Tso-Lei Yen, Oklahoma City, Okla.

Applying for Member

George Hansson Blessis, Ithaca, N.Y.
Tracy Paul Boudreaux, Houston, Texas
Richard Kyle Bowler, Los Angeles, Calif.
Henry David Bowling, Danville, Va.
Wesley L. Burgan, Colorado Springs, Colo.
D'Monte Wilcox Coombs, Provo, Utah
David Harry Cramer, Kansas City, Mo.
Robert William Charles Dannemann Wachnitz, Santiago, Chile
Stuart Llewellyn Davis, Washington, D.C.
Angelo Joseph Ferrara, Washington, D.C.
Irving William Finberg, Cambridge, Mass.
Edward Robert Foss, Jr., Venezuela, South America
George William Gaines, Mobile, Ala.
Alexander Gilad, Savyon, Israel
Bela Gombossy, Ames, Iowa
Robert Walter Haselwood, Honolulu, Hawaii
Per Anders Hedar, Goteborg, Sweden
Maximiliano Vicente Isoba Garcia, Havana, Cuba
James Best Jackson, Jacksonville, Fla.
John Dupuy Josey, Jr., El Paso, Texas
Imre John Kausz, Reading, Pa.
Francis William Kelly, Philadelphia, Pa.
Herbert Warren Kenyon, Gales Ferry, Conn.
Ralph Koliner, Villanova, Pa.
Joe Overton Ledbetter, Austin, Texas
Charles Anthony Leonard, Port Hueneme, Calif.
Dexter Gilbert Lien, Tacoma, Wash.
Jorge Liki, Sao Paulo, Brazil
Alastair Kinross MacDonald, London, England
Rolland Frank Maxson, Dillsburg, Pa.
Lynn Maynard McCrum, New York, N.Y.
James Wilbur Moore, Corning, N.Y.
Edward Francis Mudra, Fresno, Calif.
Nkemka Obieze, Liberia, West Africa
Oluf Christian Agerfeld Pedersen, Pasadena, Calif.
Yashwant Dhondo Pendse, Poona, India
Thornton Edward Piersall, Anaheim, Calif.
Robert Joseph Roza, San Pedro, Calif.
Steven Herbert Sassoon, Carmel, Calif.
Serge S. Schewyakow, San Francisco, Calif.
Shambhu Datta Sharma, Roorkee, India
Paul A. Sieverling, Passaic, N.J.
Surendra Prasad Sinha, Ames, Iowa
Harry William Skahn, New York, N.Y.
Harold Ashley Snyder, Glendale, Calif.
Louis Theodore Stachel, Mobile, Ala.
Raymond John Tolcher, Kingston, Jamaica, West Indies
Eric Knight Weber, Camp Hill, Pa.
Ray Francis Weisent, Cincinnati, Ohio
Ronald Malcolm Wild, Southern Rhodesia, Africa
Ernest Arthur Withers, Covina, Calif.
Bernard Lawrence Woerner, Indianapolis, Ind.

[Applications for the grade of Associate Membership from ASCE Student Chapter Members are not listed.]

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News of Members

(Continued from page 22)

Harry Lake Bowman, retired last month as dean of the Faculty at the Drexel Institute of Technology in Philadelphia, Pa., concluding 35 years of service to the school. Dr. Bowman joined Drexel in 1926 as professor and head of the department of civil engineering, becoming dean of the College of Engineering in 1953 and, then, in 1958 dean of the Faculty. In past years, he has had extensive private and public consulting experience as director of the Physical Damage Division of the U.S. Strategic Bombing Survey, as consultant on weapons effects and protective construction for the Atomic Energy Commission, and as consultant on blast effects for the Air Force. Meanwhile, **LeRoy A. Brothers,** dean of the College of Engineering, will be acting dean of the Faculty.

Lloyd Gensel, until recently executive assistant to the DeKalb (Ga.) County Commission Chairman, has been reassigned as general manager of the county's newly consolidated water and sewer departments. For the past four years he has served in the executive assistantship after earlier experience as regional director in the Public Buildings Service of the General Services Administration.

Thane E. Brown, since 1955 chief engineer of the Portland Commission of Public Docks, was honored recently in Baltimore by those assembled for the 20th International Navigation Congress. In 1951, after several years as chief design engineer and later as chief engineer, Mr. Brown left the Dock's Commission to join a Portland heavy construction firm, returning to the post of chief engineer four years later.

Arvon L. Davies has been promoted to vice president in charge of administration of the Chemstrand Corporation at Scarsdale, N.Y. He joined Chemstrand in 1951, serving as assistant to the president, director of overseas operations, and during his stay in England as managing director of Chemstrand Ltd., a wholly-owner subsidiary of the Chemstrand Corporation. Upon his return to the United States he became executive director of administration for the parent company.

William A. Jacoby is now city engineer of Allentown, Pa., after more than 34 years of service to the city. Starting in 1927 as a transitman with the Bureau of Engineering, Mr. Jacoby has since served as inspector, engineer draftsman, assistant city engineer and associate city engineer.

Wilbur S. Smith, of Wilbur Smith and Associates, announces the recent opening of a New York office at 30 Rockefeller Plaza. The organization now maintains offices in San Francisco, Calif., Columbia, S.C., Richmond, Va., and Winston-Salem, N.C., as well as overseas offices in London, England and Colombo, Ceylon. The firm, whose home office is in New Haven, Conn., is active in the areas of urban redevelopment, highway planning, parking, traffic control, economics and fiscal studies and, in general, research in transportation.

Robert W. Christensen, currently director of the capital improvements program division of Chicago's Department of City Planning, will shortly take over new duties as executive director of the Chicago Public Building Commission. Since joining the department of city planning in 1958, Mr. Christensen has been in charge of the preparation of the city's five year improvement program.

E. T. Coronato, whose most recent position was as structural engineer with the Robins Engineers Division of Hewitt-Robins, Inc., in New York City, has now entered the private consulting field with offices in Upper Montclair, N.J. In past years he has worked as a structural engineer for George L. Dahl, architects and engineers of Dallas, Texas, and in a similar capacity for the New York firm of Ammann & Whitney.

H. J. Cowan, professor and head of the Department of Architectural Science at Australia's University of Sydney, is currently visiting universities and building research organizations in thirteen countries. During this tour Professor Cowan plans to deliver lectures at a number of American and Canadian universities.

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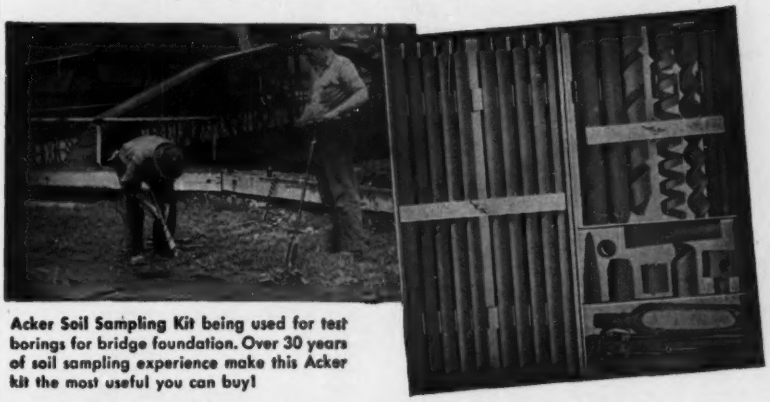

Acker Soil Sampling Kit being used for test borings for bridge foundation. Over 30 years of soil sampling experience make this Acker kit the most useful you can buy!

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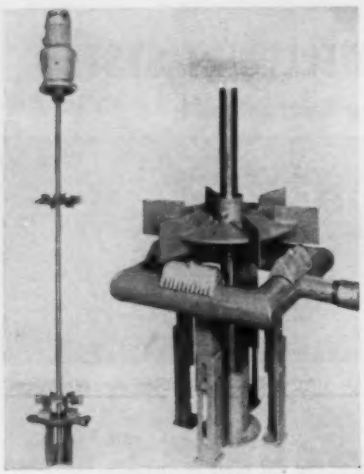
THE MECHANICOMB is a total oxidator-aerator that facilitates and accelerates the treatment of sewage and industrial wastes. It is a diffusion aerator, mechanical aerator, and agitator all-in-one—utilizes sparged air and atmospheric air—and achieves total oxidation through complete aeration-mixing, constant agitation, and continuous diffusion. As it introduces and



Oxidator-Aerator Unit

distributes air at the desired rate, the tank contents are kept violent and in intimate contact with this air to assure the greatest amount of oxygen absorption and aeration mixing. This integrated unit provides maximum flexibility for large and small sewage and industrial waste treatment plants which require treatment by aeration for total oxidation or the standard activated sludge methods of treatment. **The American Well Works, CE-11, Aurora, Illinois.**

Paver Control System

THE PURPOSE of the Electromatic Screed Controller System is to assure accurate control of mat depth or thickness and to provide a precise slope angle for the crown of the road. One result of its use, is to permit high speed paving, making it unnecessary to tear up and re-lay unacceptable bumpy stretches. The first course can be laid to an accurate, even elevation over the roughest subgrade. The amount of mix required for laying the second course can be predetermined, allowing the contractor an exact cost estimate.

Basically the electromatic screed control consists of six components; a command panel, pendulum, grade sensor, control box and a servo-motor located on each side of the paver. The command panel, sensor and pendulum feed electric signals based on desired and existing grade slope into the control box. Using this data, the control box electrically controls the servo-motors to vary the screed attack angle, automatically compensating for any road irregularities. **Iowa Manufacturing Co., CE-11, Cedar Rapids, Iowa.**

Automated Batching Plant

A HIGH SPEED, automated batching plant producing 6 cu yd of pre-mix concrete per min replaces four previous plants and reduces operating costs at Pre-Mix Concrete Co., San Diego, California. An automated batching console on the batch deck operates the batching, dumping and mixing cycles completely and automatically. Up to 24 mix designs are pre-set on the console. For charging 8 cu yd trucks, the console automatically weighs out the aggregates and cement according to the design selected, charges the mixer, times the mixing cycle and automatically dumps mix. Simultaneously, a second 2⅗ yd batch is automatically weighed and held until the first batch is mixed and dumped. The cycle repeats until 8 yd of mix is in the gob hopper. Full moisture compensation is provided on both sand and water. **Noble Company, CE-11, 1860 7th Street, Oakland, California.**

Boring Machines

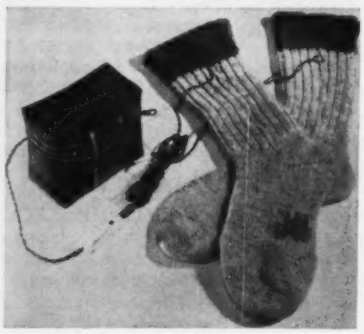
HORIZONTAL BORING MACHINES, capable of drilling horizontal or inclined holes from 6 to 60 in. in diameter and over 300 ft long, can drill up to 2 ft per minute. This machine drives steel casings as it digs and may also be used without drill head to jack concrete pipe. A heavy-duty 120 hp industrial engine with 4-speed transmission produces 15,000 to 19,000 ft-lb of torque at the drill head. Hydraulic rams, actuated by a heavy duty hydraulic 50 gpm pump produce up to 300 tons of thrust. Loose material is carried back to the work pit by auger-type flight conveyors. **Calweld, Inc., CE-11, 7222 E. Slauson Avenue, Los Angeles 22, California.**

Steam Laboratory

THE STEAM LABORATORY, an aid for college engineering students, demonstrates the application of thermo-dynamic principles involved in steam turbines used for electric power generation. Among the characteristics that can be shown are efficiency, flow-load performance, and the effects of inlet pressure-temperature and back pressure variations. A turbine-generator set consisting of a 3750-rpm, 110-volt, d-c generator driven by a single-stage 2-row, impulse-type steam turbine is the key component of the unit. The speed control governor is a direct acting mechanical type with 6 to 8 percent speed regulation. A manual speed changer controls the operating speed independently of the speed control governor. The generator is self-excited and has a compound wound field. Other major components of the new unit are a four pass surface condenser with extra large hot well, an electric condensate pump, an air ejector, an electric steam superheater and associated controls, and a power panel. **Westinghouse Electric Corporation, CE-11, P. O. Box 2099, Pittsburgh 30, Pa.**

Electrically Heated Socks

ELECTRICALLY HEATED SOCKS, made of wool with nylon reinforcement, are a boon to Engineers, Contractors, Sportsmen and all those who have to be outdoors during the winter months. Tiny warming wires are located at the toe area to provide warmth to the extremities. The socks are calibrated to heat to 110 deg and are perfectly safe to wear even with a boot full of water. The heat is provided by means of two standard 6 volt lantern



Battery-Operated Socks

batteries carried in a case which attaches to your belt. Connecting wires run from the battery case down the trouser legs to the socks where "snap-on" connectors are provided. All wiring is fully insulated and provides for complete freedom of movement. The socks are available in sizes 10, 11, 12 and 13 and retail at $14.95. **Taylor Sales Company, CE-11, 226 West Wayne Avenue, Wayne, Pennsylvania.**

(EM&M Section to be continued on page 113)

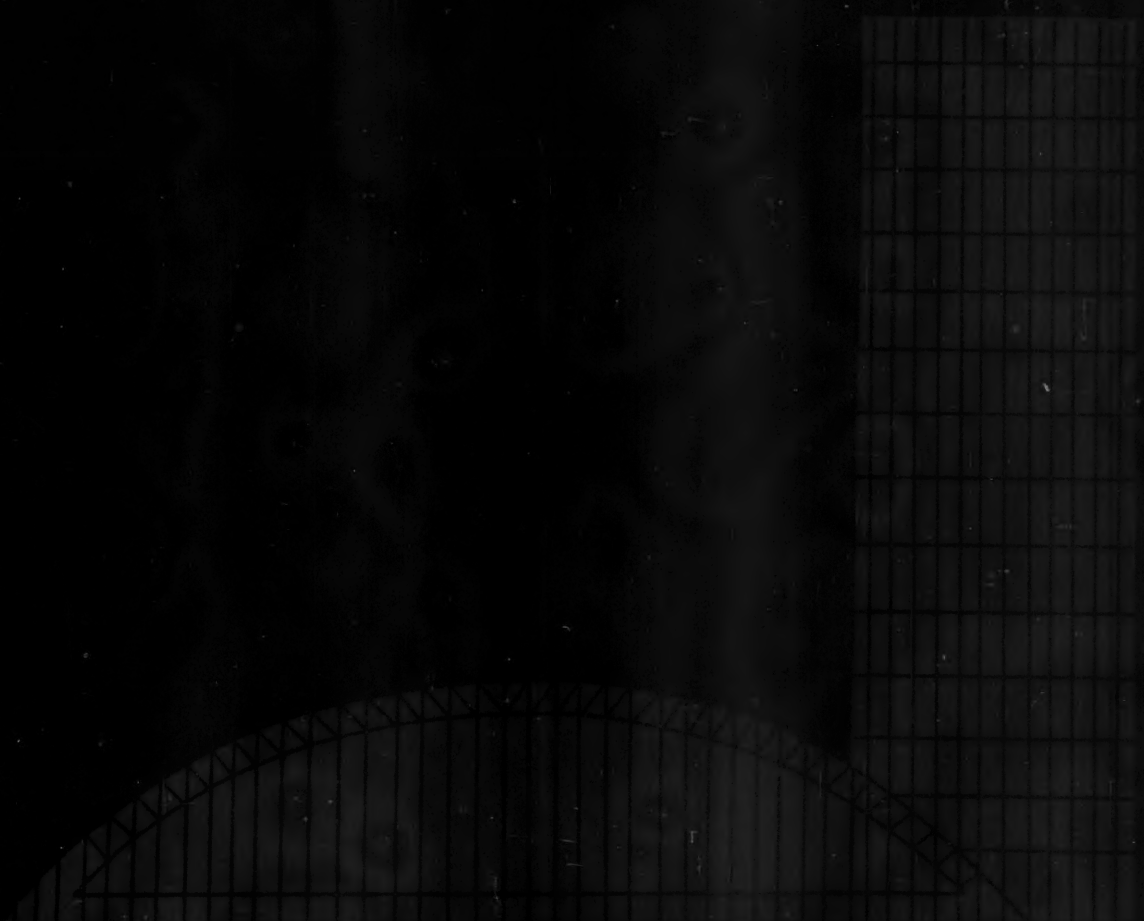
Take a good look at what you can do with the complete family of USS Design Steels

Over the past 50 years, the steel industry has developed at least 10,000 new steels! Many of these steels have been proved thoroughly on the job and wait only for the design magic of the right engineer, the right architect or the right designer to put them to use in stronger, safer and more economical structures.

Designers of buildings and bridges now have a whole "family" of USS Structural Carbon Steels, High Strength Steels and Constructional Alloy Steels available in the necessary shapes with minimum yield points ranging from 32,000 psi to 100,000 psi.

Several bridges and buildings have already been built combining these various steels into one structure to obtain maximum strength, light weight and economy—but all kinds of interesting developments lie ahead. It should be a challenge to designers to get the most out of every steel!

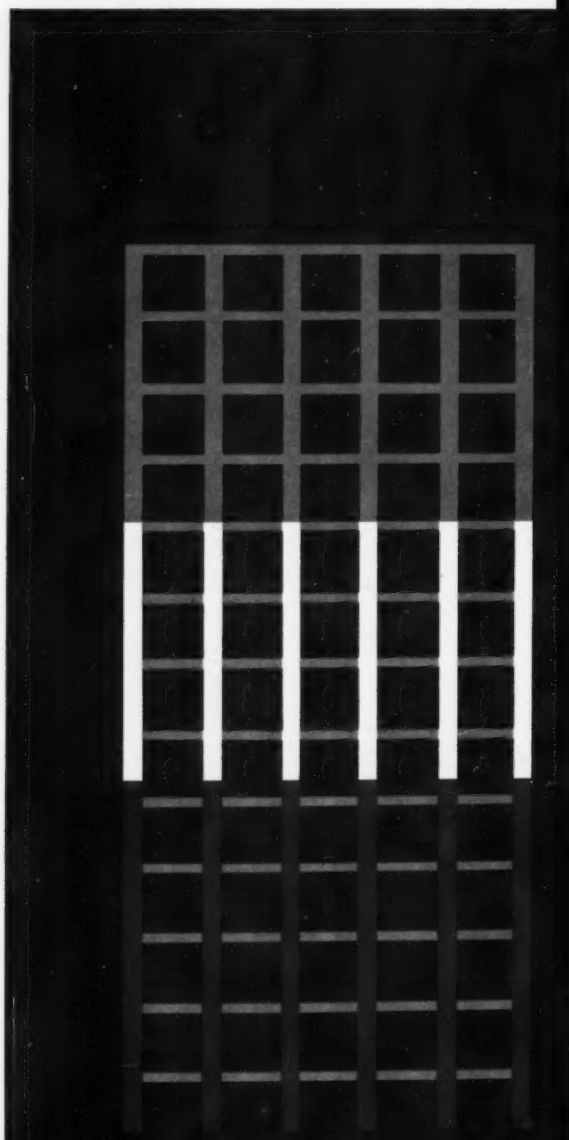
USS United States Steel



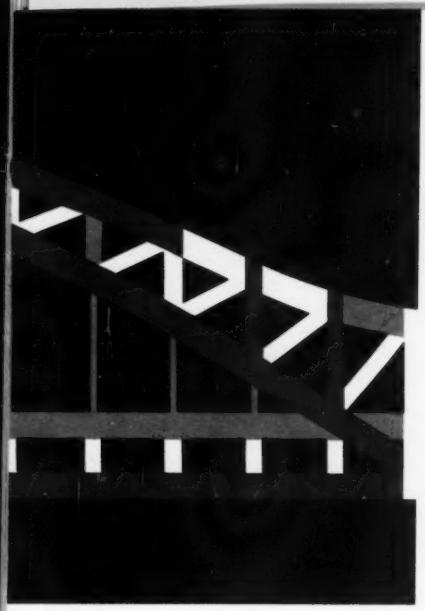
See the next two pages

New concept of design for buildings and bridges—get the most out of the family of steels by using them wherever they will improve design, reduce weight or effect over-all savings in construction.

USS Design Steels that do the most to reduce construction costs



This mark tells you a product is made of modern, dependable Steel.



Pound for pound, these stronger steels shoulder heavier loads . . . or they reduce the size and weight of structural members and foundations. They add valuable floor space to buildings, reduce freight costs and result in faster erection with earlier occupancy . . . all money-saving advantages.

New design concepts are emerging that challenge the designer's imagination and ingenuity. The combining of many steels to get the most out of them has long been practiced by automotive engineers and some other designers. It has given us the best automobiles, the highest television towers in the world, the largest earth-moving equipment and giant radio telescopes.

ASTM A7 Structural Carbon Steel is a mighty versatile and potent metal. No other material so strong (minimum yield point 33,000 psi) and selling at a material cost of less than 10 cents a pound, can be drawn, welded, forged, riveted, punched, and painted so readily and safely. A more weldable carbon steel (A373) has a minimum yield point of 32,000 psi.

ASTM A36 Structural Carbon Steel. The higher yield point of 36,000 psi and the low price indicate that this important new steel may become the predominant structural grade, and that it may displace A373 in welded construction. A36 steel gives the designer the opportunity to provide lighter-weight structures at a low cost. It has been accepted for both building and bridge construction at a basic allowable design stress 2,000 psi higher than A7 steel (20,000 allowable design stress for bridges, 22,000 for buildings). It can be used for riveted, bolted and welded fabrication.

USS High Strength Steels

All have minimum yield points of 50,000 psi. Each has specific area applications where it will do the very best job.

USS MAN-TEN Steel (A440) is a high-strength carbon steel intended for riveted and bolted construction. It is the most economical of the high-strength steels; has good workability, high resistance to abrasion, and atmospheric corrosion resistance double that of plain carbon steel. Since it provides a yield point 50% higher than A7 steel, engineers can design with higher unit working stresses and achieve *real* reductions in steel size, weight and costs.

USS TRI-TEN Steel is a high-strength low-alloy steel intended primarily for use in welded construction. This steel meets all requirements of ASTM A441. It provides greater toughness, even at low temperatures, and has twice the atmospheric corrosion resistance of carbon steel. TRI-TEN Steel has been widely used for bridges, buildings, machinery and railroad equipment to reduce weight and costs or to provide increased strength and load capacity without increased weight.

USS COR-TEN Steel is recommended for all applications in which relatively high resistance to atmospheric corrosion is considered necessary. It permits the use of thinner sections to take advantage of the increased strength of the material, or the use of equal or heavier thickness for extended life *with or without protective coating.* Paint lasts up to twice as long on COR-TEN Steel as it does on carbon steel.

USS "T-1" Constructional Alloy Steel. This is the "superman" of structural steels with a minimum yield strength of 100,000 psi. It is furnished quenched and tempered and is readily weldable. It has four to six times the atmospheric corrosion resistance of structural carbon steel and possesses exceptional toughness over a wide range of temperatures down to −50°F. "T-1" Steel combined with USS TRI-TEN High-Strength Low-Alloy Steel and carbon steel has already been used in a number of bridges. In Carquinez Strait Bridge in California, it saved $800,000 with big savings in weight. This led to its use in Martinez Bridge nearby, Louisville-New Albany, Whisky Creek and others under design. "T-1" Steel is available in standard structural shapes as well as bars, semi-finished and sheets.

USS "T-1" type A Constructional Alloy Steel. This is a lower-priced steel with the same high yield strength of 100,000 psi in thicknesses up to 1 inch. It can be used in highly stressed members to obtain maximum strength, with reduced size, weight and costs. It is available in the same shapes as "T-1" Steel.

For more information on any of these USS Steels, write United States Steel, 525 William Penn Place, Pittsburgh 30, Pennsylvania.

USS, "T-1," MAN-TEN, TRI-TEN, and COR-TEN are registered trademarks.

United States Steel Corporation • Columbia-Geneva Steel Division • Tennessee Coal & Iron Division • United States Steel Supply Division • United States Steel Export Company

United States Steel

USS

Red—USS "T-1" Constructional Alloy Steel (100,000 psi minimum yield point)

White—USS MAN-TEN High Strength Steel (ASTM A440—50,000 psi minimum yield point)

Gray—USS Structural Carbon Steel (ASTM A36—36,000 psi minimum yield point or A7—33,000 psi minimum yield point)

Now Available...

USS QUENCHED AND TEMPERED STRUCTURAL SHAPES

in such grades as "T-1", "T-1" type A, 9% Nickel and HY-80 Constructional Alloy and Armor Steels

Announcing another industry "first" for United States Steel—USS Quenched and Tempered Alloy and Armor Steel Structural Shapes are now commercially available for the first time anywhere, in the types and sizes shown in the accompanying tables. The more commonly used sizes of Wide Flange Beams, American Standard Beams, Channels, Equal Angles and Unequal Angles will be produced in these USS Steels: "T-1", "T-1" type A, 9% Nickel, HY-80 and certain other alloy grades that provide desirable mechanical properties after quenching and tempering. Later, other sizes and shapes will be added according to demand.

These quenched and tempered alloy and armor steel structural shapes (see table below) can simplify design and result in substantial weight savings, increased structural strength and reduced shipping and handling costs. For a free folder about any of these steels or their structural shapes, contact your local USS representative or write to United States Steel, 525 William Penn Place, Pittsburgh 30, Pa. USS and "T-1" are registered trademarks.

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Availability Quenched and Tempered standard structural shapes are available in the following shapes and sizes:

I	Beams: 8″ to 16″ inclusive	Selected Wide Flange Sections and Foot Weights*
I	Beams: 6″ to 12″ inclusive	American Standard Sections and Foot Weights*
[	Channels: 6″ to 15″ inclusive	American Standard Sections and Foot Weights*
L	Equal Angles: 3″ to 8″ inclusive	Standard Sections*
L	Unequal Angles: 3½″ x 3″ to 8″ x 6″ inclusive	Standard Sections*

*See our booklet, "USS Shapes & Plates," ADUCO-27001

Maximum length 40′ for all sections

Mechanical Properties of Quenched and Tempered Alloy and Armor Steel Structural Shapes

	Yield Strength, psi	Tensile Strength, psi	Elong. in 2″, % min.	Reduction of Area, % min.	Longitudinal Charpy Impact (when specified)	
					Keyhole	V-notch
"T-1" Steel 2½″ and Under	100,000 min.	115,000/140,000	18	55①	15 ft.-lbs. @ −50F	30 ft.-lbs. @ +10F
"T-1" type A 1″ and Under	100,000 min.	115,000/140,000	18	55①	15 ft.-lbs. @ −50F	—
Grade A 9% Nickel	60,000 min.	90,000 min.	22% min.	—	15 ft.-lbs. @ −320F	20 ft.-lbs. @ −320F
Grade B 9% Nickel	65,000 min.	95,000 min.	20% min.			
HY-80 ¼″-2″ Incl.	80,000/100,000②	—	19③	—	—	70 ft.-lbs. @ −120F

①¾″ and under—45% min.
②½″ and over, yield strength range is 80/95,000 psi
③½″ to 2″ inclusive, elongation 20% min.

USS United States Steel

EQUIPMENT MATERIALS and METHODS

(continued)

Cotterless Hitch Pin

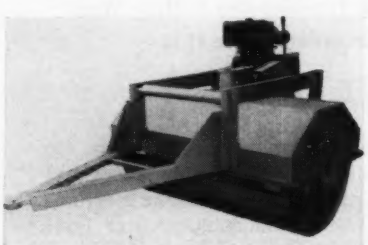
THE MAIN BODY of the pin is made of cadmium plated steel and the working parts are of stainless steel. The pin is used for temporary or interchangeable hitching of parts, tools, units, assemblies, etc. where it is desirable to eliminate cotter pins and other locking devices. The

Pointed Hitch Pin

pointed end facilitates the proper alignment of the two holes and the large head provides a means of quick removal. The pin comes in all sizes with one or several locking points positioned where desired in the body of the pin, as required by actual use. **Rein Leitzke, CE-11, Dept. HP, Hustisford, Wisconsin.**

Vibrating Roller

THE VIBRA-PACTOR, VP-2G, is designed for use by contractors who require a variable operating frequency of from 1500 to 4000 vibrations per minute. The mechanism consists of four synchronized eccentric weights, which are timed with hardened gears and fully enclosed in an oil-tight case. Powered with a 7 hp engine,



Variable-Frequency Roller

the 3200-lb vibrating force delivers a maximum applied force of 4950 lb at 4000 vibrations per minute. When used as a static weight roller, it may be filled with 169 gal of water to bring total weight up to 3116 lb. Its overall width is 68¼ in. and length with tongue, 94 in. **Bros Incorporated, CE-11, Minneapolis 14, Minnesota.**

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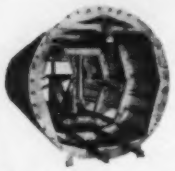

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EQUIPMENT, MATERIALS and METHODS

(continued)

High Speed Motion Pictures

THE STEREOFLEX MODEL A camera takes up to 15,000 3-D pictures every second. When these pictures are viewed on a special projector, they are in slow motion which reduces the speed of the operations by as much as 1,000 times. The camera uses a system of mirrors to achieve its 3-dimensional vantage points. The mirrors are adjusted along a track in front of the camera and tilted to bring the desired image coverage to lenses mounted at right angles to the viewing axis of the camera. Two 16mm images are recorded side-by-side on a single strip of 35mm film. This film is then shown on a projector designed so that the images can be adjusted on the screen for 3-dimensional viewing. **Benson-Lehner Corporation, CE-11, 1860 Franklin, Santa Monica, California.**

Miniature Recording Voltmeter

THE AMPROBE RECORDER VOLTMETER, a miniaturized precision recording instrument, will make a legible, permanent record on a moving paper tape (2½ in. x 35 ft). It is inkless and uses smudgless, pressure sensitive paper which is not affected by heat, cold, moisture, humidity or fumes. The paper feeds at a speed of 12 in. per hour through a jam-proof, maintenance-free drive train. The paper moves over the meter movement, under a viewing window (through which pencilled notes may be written) and out through a slot. The recorder is available in two models: regular scale: 0/150/300/600 VAC and with an expanded scale: 95 to 130, 190 to 260 VAC. **Amprobe Instrument Corporation, CE-11, 630 Merrick Road, Lynbrook, New York.**

Tractor-Shovel

FULL HYDRAULIC POWER STEERING and oil-cooled power brakes feature the introduction of a 1¾ cu yd capacity HD-7G tractor shovel. Powered by a 100 hp turbo-charged diesel engine, the tractor's torque converter performance is combined with a single lever power shift transmission. The working speed is up to 5.9 miles per hour forward and 4.2 miles per hour in reverse. The ground speed control governor allows the operator to pre-set any working travel speed to match job conditions. It has 7 ft. 1⅝ in. of track on the ground, 62-in. wide tread, and 15-in. standard shoes. **Allis-Chalmers, Construction Machinery Division, CE-11, Milwaukee 1, Wisconsin.**

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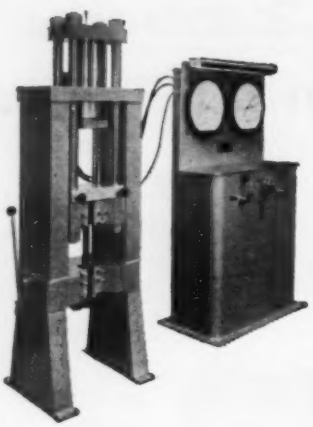

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RECORDING METER AND PNEUMATIC METER—Bulletin 405 describes a pre-engineered standard capacity unit used with a 90 and 60 deg "V" notch weirs. It is specifically built for operation with small, or packaged type, sewage disposal plants. Bulletin 729 describes an instrument incorporating a pneumatic receiver to take any form of pneumatic signal. **Simplex Valve & Meter Co., CE-11, 7 E. Orange St., Lancaster, Pa.**

PUMP LINE—A different approach in bulletin layout and content is used in Bulletin 124-G to introduce a line of vertical, enclosed-shaft, non-clog VCS pumps. Followed in logical order are easy to use pump and motor selection tables; preliminary layout dimension data on the pumps, basins and basin covers; engineer specifications; illustrated details of the necessary controlling devices, optional equipment and installations. **Chicago Pump, CE-11, 622 Diversey Parkway, Chicago 14, Illinois.**

PRESSURE TREATED TIMBER FOUNDATION PILES FOR PERMANENT STRUCTURES—is the title of a 62-page book, detailing reports of five recent loading tests in Chicago, New Orleans, Texas, California and Washington. Described is the method of reducing foundation costs by increasing ultra-conservative design loads from 15 to 35, 40, and 50 tons for timber piles. Complete specifications for the selection of timber, preservatives and treatment are included with foundation design and driving data. **American Wood Preservers Institute, CE-11, 111 W. Washington St., Chicago 2, Illinois.**

TIGER CRANE—Bulletin No. 95, a 6-page color brochure, illustrates and describes this heavy-duty standard crane. It is available in capacities from 5 to 30 tons for Class D crane service. **Whiting Corporation, CE-11, Harvey, Ill.**

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ELECTRONIC DISTANCE MEASURING—A miniaturized version of the Raydist DM system, is a portable, small, lightweight system which can be transported and installed in a few minutes in any location. It has the same basic accuracy as the larger systems and will operate automatically. The range over sea water will exceed 25 miles. **Hastings-Raydist, Inc., CE-11, Hampton, Va.**

MAINTENANCE OF ASPHALT PAVEMENTS—Keeping pavements in full service with minimum expense and least inconvenience to traffic is the subject of this 23-page booklet, Information Series No. 117. Maintenance operations, procedures and patching are given complete coverage. **The Asphalt Institute, CE-11, College Park, Maryland.**

STANDARD BORING SPECIFICATION—This pamphlet, "Recommended Standard Boring Specification For Cased Borings", is designed to help standardize contract specification requirements in the Metropolitan area of New York and the method of performing foundation test borings. **Test Boring Contractors Association, CE-11, 11 West 42nd Street, New York 36, New York.**

CRUSHING PLANT CATALOG—Catalog 697, describing 18 different models of portable jaw crusher primary plants, contains flow diagrams, basic specifications and field photos of this equipment in operation. Included, in addition to the basic primaries, are the new PRSC Plants equipped with Mesabi vibrating screens that permit removal of fines and sized products ahead of the crusher. **Pioneer Engineering, Div. of Poor & Company, CE-11, 3200 Como Avenue, S.E., Minneapolis 14, Minnesota.**

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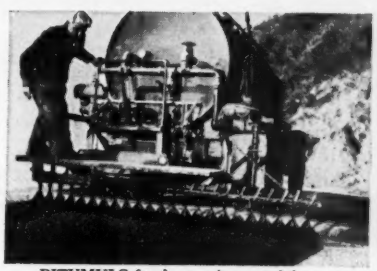

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GENERAL ENGINEER, M. ASCE, B.S., B.C.E. Five years in hydrology, hydraulics, flood control, engineering studies and design with Corps of Engineers and Bureau of Reclamation, and eight years in construction, five of which were spent as Chief of Engineering Division, Post Engineers, Fort Bragg, N.C. C-720.

PROJECT ENGINEER OR SUPERVISORY DESIGN ENGINEER, M. ASCE, B.S.C.E., M.S.E. Over twelve years' of diversified experience on bridges and special structures, including complete administrative direction of jobs and supervision of design, detailing and drafting. Salary, $12,000. East; foreign. C-721.

SANITARY ENGINEER OR PROJECT ENGINEER, B.S.C.E., M. ASCE, 37. Broad background in consulting on water, sewage and industrial waste treatment projects, includes supervision of design, construction, reports, estimates and specifications, client liaison and public relations work and experience as resident engineer. Additional experience, such as selling, gained in office of manufacturer. Salary, $12,000-$15,000. Midwest. C-2288-Chicago.

CHIEF ENGINEER OR MANAGER OF STRUCTURAL STEEL FABRICATING PLANT, M. ASCE, B.S.C.E., 46. For twenty years (except four years' active duty with Corps of Engineers) in structural steel fabricating; serving in all capacities—draftsman, estimator, sales engineer, chief engineer and assistant to the manager. Salary, $12,000-$15,000. South or Midwest. C-2289-Chicago.

CONSTRUCTION SALES ENGINEER, M. ASCE, C.E. courses, 57. Engaged in the sale of heavy construction equipment for 16 years as factory representative and employee of distributor organization; was supervisor of heavy construction, dams, power plant and waterfront for ten years; and supervisor of Federal soil conservation projects for another seven years. Qualified for ready mix concrete operation, gravel production, equipment, sales or heavy construction. Salary, $12,000. Prefer Michigan area. C-2290-Chicago.

CIVIL ENGINEER AND LAND SURVEYOR, M. ASCE, B.S. and M.S. in C.E., 34. Ten years top experience with municipalities and consultant in expressway design, sewage treatment studies, land development, water supply and distribution, and flood control. Salary, $10,000. Midwest. C-2292-Chicago.

PROJECT COORDINATOR, F. ASCE, B.S.C.E., reg. Structural Engineer, 54. In the part has had responsible charge of architectural, structural and mechanical planning of large medical, commercial and industrial projects. Salary, $17,000. Chicago area. C-2293-Chicago.

STRUCTURAL ENGINEER, A.M. ASCE, B.S. in C.E., registered P.E. in Illinois, 30. Three years' experience in design of industrial buildings, bridges, foundations and towers, plus two and a half years' experience in the design, analysis, and supervision of drafting, manufacturing, construction and erection of large microwave antennas. Salary, $10,000. Will relocate. C-2294-Chicago.

CIVIL ENGINEER, M. ASCE, B.S. in C.E., 39. Fifteen years' experience in highway and bridge construction, including six years as resident engineer on all types of highway construction and another six years as assistant resident engineer on large urban bridges, expressways, and interchanges. Salary, $7,000 plus. Midwest. C-2295-Chicago.

ENGINEERING DESIGN CONSULTANT, F. ASCE., CE, MS Structural. Reg. P.E. Illinois, 39. Over a thirteen year period was structural designer, planner, supervisor and inspector in the oil production and bridge construction fields. Salary, $9,000. Se-1299.

CONSULTING ENGINEER OR MANAGER, F. ASCE, CE, 58. Four years spent as area engineer, district engineer, deputy division engineer and post engineer in charge of all design and construction of air fields, industrial buildings, barracks, family housing, and utilities plants and systems. Background also includes work on dams, flood control and docks. Qualified as city manager, director of public works or city engineer. Salary, $10,000-$15,000. Southwest, South. SE-1450.

This is only a sampling of the jobs available through the ESPS. A weekly bulletin of engineering positions open is available at a subscription rate of $4.50 per quarter or $14 per annum, payable in advance.

DESIGN RESEARCH ENGINEER AND SOIL MECHANICS ENGINEER, M. ASCE, CE, 37. In the field of applied soils mechanics for six years. Exploration of sites with drilling equipment, included analysis, laboratory, and report work, or well as work in planning, design and construction. Also experienced with water utilities, subdivisions, highways, and buildings. Salary, $700. San Francisco Bay Area. SE-1430.

CONSULTING DESIGN ENGINEER, A.M. ASCE, CE. 27. For six years worked on interstate and defense highways, freeways, and drainage, in various capacities—design, details, layout, reports, supervision. Salary, $500. San Francisco Bay Area. SE-1417.

ENGINEER FOR ELECTRIC UTILITIES, M. ASCE, CE, 45. For 20 years was in electric utilities field engaged in engineering and administrative work. Se-1582.

Positions Available

SENIOR ESTIMATOR, with 10 years of commercial and industrial building construction experience, to supervise quantities, price jobs, do purchasing, expediting, etc. in contractor's office. Salary, $9,000-$10,000. Conn. W-866.

CHIEF ESTIMATOR, must be capable of making complete quantity takeoff and of pricing labor under union field conditions; must be familiar with demolition, earth work; concrete construction, masonry, and carpentry (rough and finished) for alteration and new construction in commercial, industrial and institutional field. Present volume in low millions. Great amount of customer contact. Salary and profit sharing arrangement. Northern New England. W-861.

CONSTRUCTION SUPERINTENDENTS, gradual civil, with experience as superintendent in charge of 8 to 10-story office buildings. Salary open. One for Wisconsin; one for South. W-854.

SUPERINTENDENT OF STREETS, engineering degree, for department of public works. Salary, $12,000-$15,000. Mass. W-850.

SENIOR ARCHITECTURAL-STRUCTURAL ENGINEER, graduate, preferably with license and at least 10 years' structural and architectural design, layout and specification experience on industrial, process and general building work. Salary $9,000-$13,000. Eastern Pa. W-843.

CIVIL ENGINEER with five to eight years reinforced concrete design and field engineering experience on flat slab apartment houses. Salary, $7,800-$9100. New York, N.Y. W-825.

PLANT ENGINEER, B.S. in Architectural, Civil, Electrical or Industrial engineering, with two to three years general plant engineering experience in metal working industry, utilities, industrial engineering or allied fields, for general plant engineering in fabrication plant with special emphasis on planning and layout of production, pilot and laboratory facilities. Will include design, specifications, cost estimates, etc. Salary, $6,300-$7,600. Pennsylvania. W-801(*a*).

REGIONAL ENGINEER, degree in either civil or architectural engineering, preferably with major in structural design. Background should include design and construction experience, either with a consulting engineering firm, with a steel fabricator, or in the teaching profession. Sales promotion experience, experience in writing technical reports or other technical writing required. In addition should have a full knowledge of Federal agencies involved in construction of bridges or buildings, as well as a knowledge of construction industry associations. Desire professional license and well-rounded background in design, construction and estimating. Some travel. Washington, D.C. W-828.

CIVIL ENGINEERS, with two to ten years experience in structural design, preferably in the field of transmission towers and other electrical facilities such as substations, particularly involving aluminum. Pennsylvania W-804.

CIVIL ENGINEERS. (*a*) Assistant Chief Civil Engineer, with at least 15 years experience in the design of major hydroelectric projects. Salary, $10,800 plus excellent benefits. (*b*) Civil Engineers, experienced in the design of major hydroelectric power projects. Salaries open depending upon experience. Colorado. W-778.

CIVIL ENGINEER, C.E., with education or experience in soils and foundations. Prefer recent graduate with P.E. license for responsible position involving technical and administrative duties with soil and foundation engineering firm. Salary, $7,200-$9,600. Washington, D.C., area. W-765.

ESTIMATOR, civil graduate, with at least five years estimating experience in building construction including alteration work. Salary, $8,000-$10,000. New York, N.Y. W-760.

SANITARY ENGINEER capable of design, including structural concrete, of water and sewerage projects; five years' minimum experience. Upstate New York. W-755.

SALES ENGINEERS, recent engineering graduates in mechanical, marine, civil or electrical engineering or with some sales or other experience with heavy machinery. Some knowledge of Spanish. Must live in Baltimore, extensive travel in Latin America. State salary. Headquarters, Maryland. W-869.

CIVIL ENGINEERS, graduate. Experience and some supervisory work in highway and sewer investigation, planning, design and construction. Will be in responsible charge of a project design and construction section, or the administration and research section of the engineering department. Salary, to $7,722 depending on experience. Illinois. C-8859.

ENGINEER ON BUILDING CONSTRUCTION, graduate C.E., EE. or M.E.; with four or more years supervisory experience with a building design firm or in construction department of large organization, plus eight years experience in actual design of manufacturing facilities and related utilities. Will consult with architects, contractors and company personnel in the supervision and preparation of sketches and drawings showing most effective space and material utilization and economy of design, as well as progress and construction of new or remodeling work for multi-plant operation in metal field. Fee paid. Salary, $8,400-$12,000. Chicago. C-8851.

ENGINEERS. (*a*) Section Head, graduate C.E. Ten years proven experience in design of power houses, tunnels and intake structure plus a knowledge of fill dams and hydraulic structures. Experience in client contact essential. (*b*) Estimator and Specification Writer, graduate C.E. with minimum of five years experience in large hydro projects. Duties consist of cost estimating, writing and reviewing specifications for a consultant. Salaries open, depending on experience. Fee paid. Chicago. C-8843.

PROJECT DESIGNER ME or CE, age open. Well qualified at consulting project level in large Hydro power dam (gates, valves, penstock), strong mechanically, to engage in or review plans and specifications, as well as deal with foreign sub-construct consultants and engineers for engineering consultant. Later will move to construction area as resident and deal with foreign contractor builders. Salary, $17,500. England. Sj-6529.

INSPECTOR, CE, age open, with recent supervision of asphalt concrete overlay for air fields, preferably foreign A/E or construction on military projects for A/E firm. Should be qualified in at least one of the following: quarry, plant, placement, test. Salary, $1,100. Japan. Sj-6521.

CITY ENGINEER, CE, California Registration, age open. A medium sized city desires applicant with more than four years experience as municipal department head, involving all engineering and public works. Salary, $10,020. California Central Coast. Sj-6512.

BUILDING SUPERINTENDENT, CE background. Extensive work on large r/c buildings, for six story dormitory buildings. Top man for busy and large California general contractor. Sj-6536.

HIGHWAY DESIGNERS, CE, 30, with several years experience on locations, drafting. Know reports writing and traffic analysis. Immediate need for consulting engineering firm. Salary, $725-$900. San Francisco Peninsula. Sj-6490.

FIELD AND OFFICE-ENGINEER, CE, age open. Should be experienced as a survey and office engineer on roads, streets and dams. Will be in charge of survey party on construction project for a contractor. Salary, $600-$800. San Francisco East Bay. Sj-6517.

LAND-SURVEYOR, CE, age open. Should have at least ten years experience, including extensive land surveying in field and office work related to subdivisions, sewer, water, plotting. For established Consultant. Employer pays one half the fee. Salary, to $750. Santa Cruz. Sj-6522.

PUBLIC WORKS SUPERINTENDENT, CE, Cal reg. Five years highway experience, plus two years administrative background for a county department. Salary, $690. South California. Sj-6548.

FIELD AIDES, CE, ME, EE or equivalent, with at least two years construction experience in field and office, preferably on large military base. Will work with quantities, costs, estimates, progress, production, records, reports, sub contracts, materials, expedite, work schedules, inspect, serveillance of work, locations, placing, layout, on sewers, water, streets, or mechanical service, or electric power, light, distribution. Negotiate fee and relocation costs. Interviews in San Francico. Apply by letter, telephone, person. Salary, $500-$700 or more Sj-6533.

FIELD AND OFFICE AIDE, CE, young. Require two or more years of combined field and office experience in highway or heavy construction, including some work assisting with quantities, falsework drawing, modifications, equipment and materials control, and expediting. Will work for a large general contractor in San Francisco. Salary, $550. Sj-6348.

DESIGNER AND INSPECTOR, CE, any age. Ablity to design and inspect public works structures and water resources as well as do subdivision work requisite for position with a Southern California, county department. Salary, $515. Sj-6547.

PUBLIC WORKS DESIGNER, for a city in Butte County, CE, any age, to supervise and perform office and field engineering in the design, construction, maintenance of streets, storm drains, sewers, structures. Salary, $504. Sj-6484.

STEEL DETAILER, CE, age open, to detail and calculate structural steel transmission towers for a large steel producer. Knowledge of truss work and link belt work, plus ability to do precise calculations desirable. Salary, $400-$650, South San Francisco. Sj-6540.

DRAFTER AND DETAILER, CE, to 50. Fabricating-construction firm wants someone with experience in shop detailing for steel service station buildings. Salary, $400-$450. Sj-6537.

ENGINEER, ME, CE, Arch., 20-27. Recent graduate with some mechanical drawing to assist chief engineer in plant layout, project management, instrument and machinery. For a laboratory precision machine shop. Salary, $450-$500. Palo Alto. Sj-6541.

INSTRUCTOR, CE or ME, age open. Academic background and desire to teach. Will start with surveying and engineering drawing. Eight and one half months teaching, and opportunity for work during vacation. Good junior college in Idaho. Sj-6525.

DESIGNER, CE. To design major hydroelectric projects (dams, spillways, outlets, intake structures, penstocks and power plant structures for Colorago engineering consultant firm. Salary open. Sj-6497.

OFFICE AND FIELD ENGINEER, CE, any age. A Government contractor manufacturing equipment requires someone with experience related to missile base launching systems, plus ability to supervise installation of large and heavy equipment (steel, concrete, foundations). Salary commensurate Idaho. Sj-6494.

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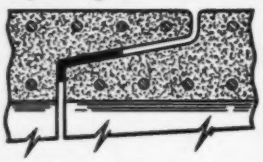

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From the MANUFACTURERS

NEW OFFICE: Sprague & Henwood, Inc. announces the opening of their new regional office in Salt Lake City, Utah . . . Establishment of office and warehouse facilities in North Carolina and Oklahoma was announced this month by the Consolidated Pipe Company of America . . . The Travelist Engineering and General Offices, A Div. of Drott Mfg. Corporation are moving to Wausau, Wisconsin where they will be consolidated with the factory and home office location there . . . **DISTRIBUTORS:** Clymar Engineering & Sales, Inc. will be exclusive distributors for Onan Div. of Studebaker-Packard Corporation . . . Monsanto Chemical Company has announced that Continental Manufacturing Company has been licensed as their exclusive agent . . . Holley-Edwards Sales, Inc. has taken over the national distributorship of grips and wedges manufactured by Cable Covers, Ltd. of London, England . . . Allied Materials Supply Company has been named national industrial distributor for the "ceramic-on-steel" building products of Caloric Appliance Corporation . . . **AGREEMENTS:** Koppers Company, Inc. has entered into an agreement with Bituminous Coal Research, Inc. which gives Koppers exclusive rights to a device and related techniques to be applied to metallurgical furnaces . . . **SUBSIDIARY:** The Jaques Cattell Press, Inc. became a wholly-owned subsidiary of the R. R. Bowker Company by purchase from the heirs of the late Jaques Cattell . . . **BUYS RIGHTS:** The Griscom-Russell Company announces the purchase of the exclusive rights to manufacture and sell deaerating heaters using designs and patents of Elliott Company, Div. of Carrier Corporation . . . **NEW DIVISION:** Conver Steel & Wire Company, Inc. has announced the establishment of a new division to be known as "Atlas Concrete Form" . . . **NEW FIELD:** Allied Chemical's Plastics Division has announced its intention to enter the polypropylene market effective November 1st . . . **NEW NAME:** The stockholders of the Vapor Heating Corporation have voted to change the name of the company to Vapor Corporation . . . **APPOINTMENTS:** Richard J. Murphy has been appointed technical service manager at the New York office of the Universal Atlas Cement Division, U. S. Steel Corporation . . . Walker Process Equipment, Inc. announces the appointment of the Ray Lindsey Company as their sales-engineering representative in Western Missouri and Kansas . . . Robert K. Stenard has joined the Chicago Heater Co. and will be in charge of the new engineering office in New York . . . The Dow Chemical Company has named Paul Meeske to the post of manager of building products . . . The board of directors of ESCO Corporation has announced the election of J. J. Davis to the presidency of the firm . . . The Pittsburgh-Des Moines Steel Company announces the appointment of W. F. Hoffman as Manager of Industrial Sales . . . D. O. Steenson has been named general supervisor, Product Quality, for International Harvester Company's Construction Equipment Division . . . Owatonna Tool Company announces the appointment of Richard Schuster to the position of Advertising and Sales Promotion Manager . . . Darrel D. Byerley of Tinker & Rasor has been appointed general sales manager of the company's newly acquired Detectron Division . . . Gene L. Bego has been named general sales manager of B. F. Goodrich Industrial Products Company, a division of the B. F. Goodrich Company . . . John J. Caton and Thomas B. Donoho have been appointed as field representatives for the Cast Iron Pipe Research Association . . . Edward L. Smith was elected Chairman of the Board of Directors of Huber-Warco Company and chief executive officer of the firm . . . George C. Wright has been appointed marketing manager of Hubbard and Company . . . Albert W. Gudal has joined Koppers de Venezuela, C. A., a subsidiary of Koppers Company, Inc. . . . Charles L. Roberts has been named manager, Power Apparatus Group, for the Minneapolis district office of I-T-E Circuit Breaker Company . . . W. W. Littlefield has been appointed as manager of Air Reduction Sales Company's Arlington District.

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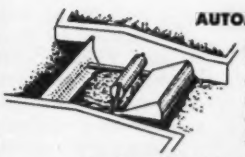

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PROCEEDINGS AVAILABLE

October

Journals: Engineering Mechanics, Soil Mechanics and Foundations, Structural, Professional Practice.

2950. Research and Civil Engineering Education, by Nathan M. Newmark. (PP) A survey of civil engineering research efforts at colleges in the United States is reported. More funds are needed to fulfill the needs of graduate education in this field.

2951. Research for Survival, by Arthur G. Trudeau. (PP) The objective of the Army Research and Development Program is to equip a man to work in a scientifically and technologically hostile environment.

2952. Research and the Professional Society, by Arthur T. Ippen. (PP) Responsibility of the professional society for the advancement of basic knowledge is developed in relation to the needs of modern society and the professional status of the engineer.

2953. Prestressed Bowstring Arch, by Movses Kaldjian. (ST) General expression and specific equations for solving prestressed bowstring arches with extensible suspension rods are presented. A simplified membrane-analogy method of solving the bowstring arch, and a laboratory investigation of models are included.

2954. Slope Stability Analysis by a New Graphical Method, by M. Arnold. (SM) The derivation of Bishop's equation for stability analysis of slopes and a new graphical method for its solution are presented. Stability analyses of slopes under unsubmerged and partially submerged conditions are given.

2955. Dynamic Response of Highway Bridges, by John F. Fleming and James P. Romualdi. (ST) The effects of vehicle and bridge variables on highway bridge impact are considered.

2956. String-Polygon Analysis of Frames with Straight Members, by Jan J. Tuma and John T. Oden. (ST) A general method for analyzing straight-membered plane frames of all types is presented.

2957. Stresses at a Re-Entrant Corner of a Plate, by Mario G. Salvadori. (ST) A method of determining re-entrant corners is studied.

2958. Vibration Analysis for Structural Floor Systems, by Lawrence R. Burkhardt. (ST) A graphical method for determining basic beam frequencies and maximum amplitudes of floor members, in order to control undesirable vibration in industrial structures, is presented.

2959. Simplified Design of Combined Footings, by Fritz Kramrisch and Paul Rogers. (SM) An empirical method for the design of continuous beam footings and grid and mat foundations is presented.

2960. Effect of Structure and Foundation Interaction, by Daniel L. Lycan and Nathan M. Newmark. (EM) Models of structures are analyzed to study errors that may occur when the record of foundation motion of one structure is used to determine the response of a dissimilar structure.

2961. Elastic Rayleigh Wave Effects Due to Nuclear Blasts, by M. L. Baron and Charles Lecht. (EM) Results are presented for the stresses and displacements due to Rayleigh Waves that are produced by transient normal pressure distributions on the surface of a homogeneous and isotropic semi-infinite elastic half-space.

2962. Multiple Ribless Shells, by Anton Tedesko. (ST) An analytical approach to the design of multiple ribless concrete shells is confirmed by the results of large scale model tests.

2963. Deflection Theory of Arches, by S. O. Asplund. (ST) Influence coefficient expressions are developed in matrix form for all section forces of an arch.

2964. Interfacial Mixing in Stratified Flow, by Enzo Oscar Macagno and Hunter Rouse. (EM) Laboratory experiments and results on the interaction of two superposed fluid streams of equal thickness and slightly different density, moving in opposite directions at essentially the same velocity, are presented.

2965. Displacement of Long Footings by Dynamic Loads, by William L. Wallace. (SM) A mathematical expression for the displacement of a long footing subjected to a peak triangular force pulse is developed from theoretical considerations.

2966. Tank Foundations in Eastern Venezuela, by Emery Carlson and Stephen Fricano. (SM) Design considerations for foundations for steel petroleum storage tanks in Eastern Venezuela are analyzed, including predicted settlements, shear failure, plastic flow, and overturning.

2967. Strength of Plate Girders in Shear, by Konrad Basler. (ST) Shear strength of plate girders is studied. New design rules are proposed and checked with ultimate load tests.

2968. Strength of Plate Girders Under Combined Bending and Shear, by Konrad Basler. (ST) Possible interaction between bending moments and shear forces on the carrying capacity of plate girders is examined. Based on theory and experiment, approximations suitable for design are suggested.

2969. Recent Advances in the Design and Behavior of Concrete Bridges, by Hubert Rusch. (ST) Principal factors influencing advances in concrete bridge design are examined. Among these are the use of high strength concretes and steels, development of prestressing, selection of structural types, and model statics.

2970. Folded Plate Structures of Light Gage Steel, by Arthur H. Nilson. (ST) A simple design theory for a new type of structure suitable for long spans is presented and tested.

2971. Analysis of Seepage Problems, by Milton E. Harr and Robert C. Deen. (SM) A problem involving flow of groundwater is solved by use of potential theory, elliptic integrals, theory of complex variables, and conformal mapping; results are summarized.

2972. Discussion of Proceedings Papers 2574, 2791, 2793, 2832. (SM) E. A. L. Smith on 2574. R. H. Grice on 2791. Richard R. Schindler on 2793. B. V. Ranganatham on 2832.

2973. Discussion of Proceedings Papers 2624, 2627, 2690, 2790. (EM) Robert K. Wen on 2624. G. Y. Sebastyan and F. Pennar on 2627. Annabel Tong on 2690. Richard G. Troy on 2790.

2974. Discussion of Proceedings Papers 2542, 2552, 2555, 2650, 2674, 2680, 2693, 2703, 2712, 2715, 2721, 2779, 2845. (ST) Thomas A. Wyatt on 2542. John E. Duberg, Narbey Khachaturian, and Raul E. Fradinger on 2552. Lynn S. Beedle and Lambert Tall on 2555. J. Morley English on 2650. D. M. Brotton, N. W. Williamson, and M. Millar, Hannsharl Bandel, W. E. Adams, Jackson L. Durkee on 2674. M. G. Salvadori and E. Heer on 2680. A. J. Durelli and T. M. Daniel on 2693. A. H. Brownfield, John H. Wells on 2703. B. J. Hartz, Phillip L. Gould on 2712. John G. Merkle, M. Gregory, A. A. Eremin on 2715. Paul H. Reimer, Miguel Angel Macías—Rendón on 2721. Alfredo H. Ang on 2779. E. I. Fiesenheiser on 2845.

2975. Atomic Power, A Failure in Engineering Responsibility, by Adolph J. Ackerman. (PP) This paper examines the application of the scientific development of atomic power for public service that has appeared on the national scene since World War II.

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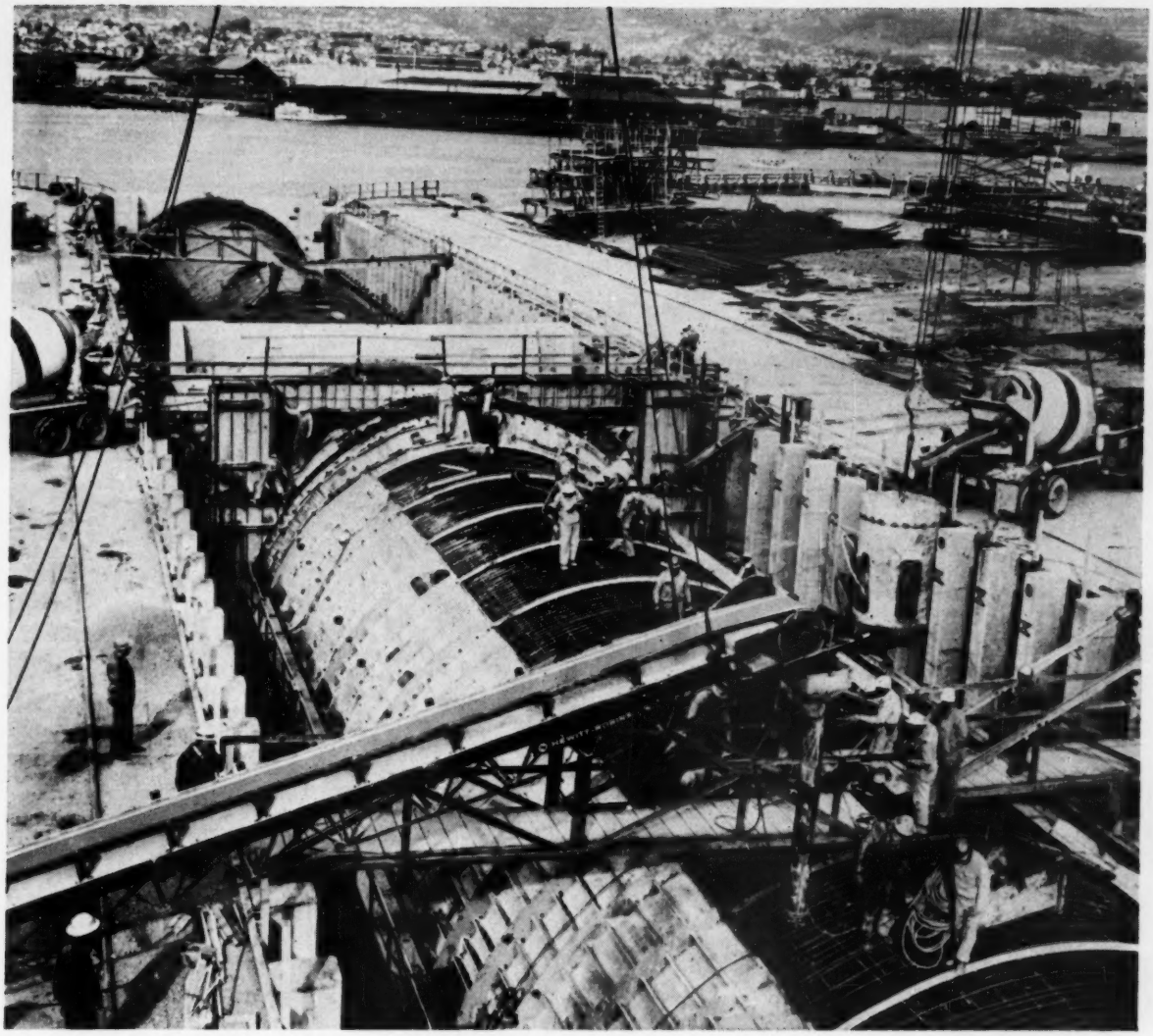

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